Visibility Data Representing Bridger Wilderness

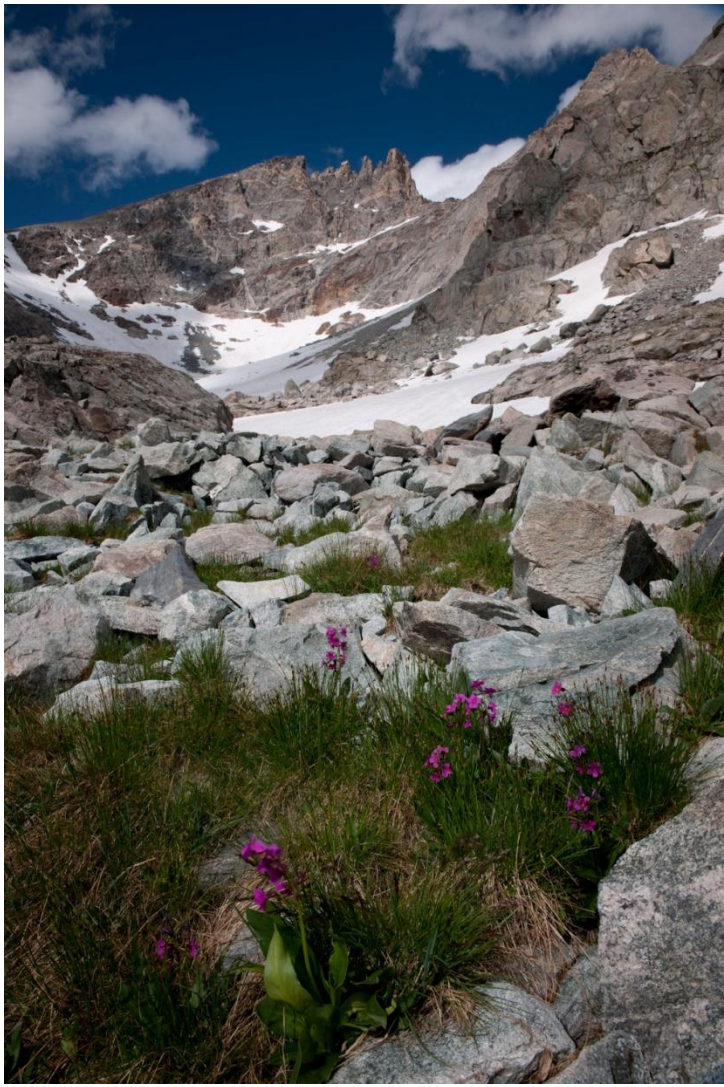
This information is preliminary. It does not reflect USDA Forest Service policy, and it is not peer reviewed.

Scott Copeland

8/8/2011

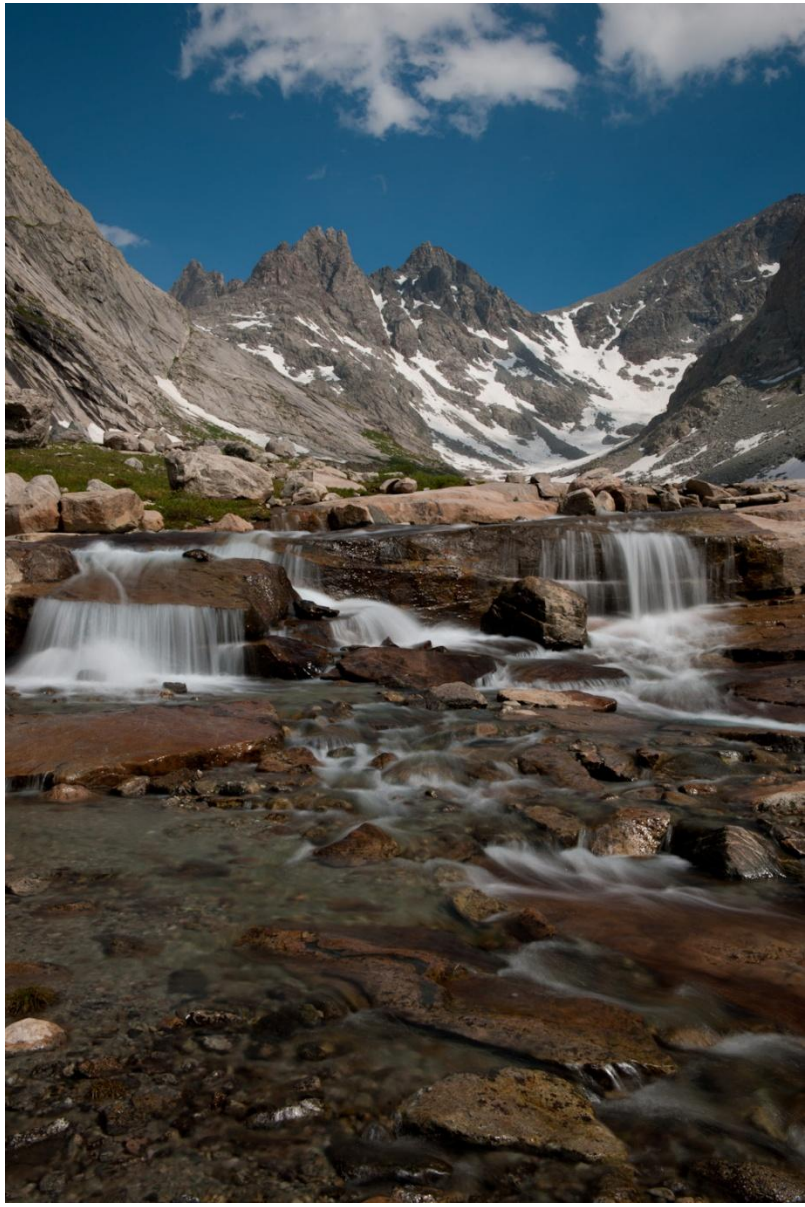
Things to Keep in Mind

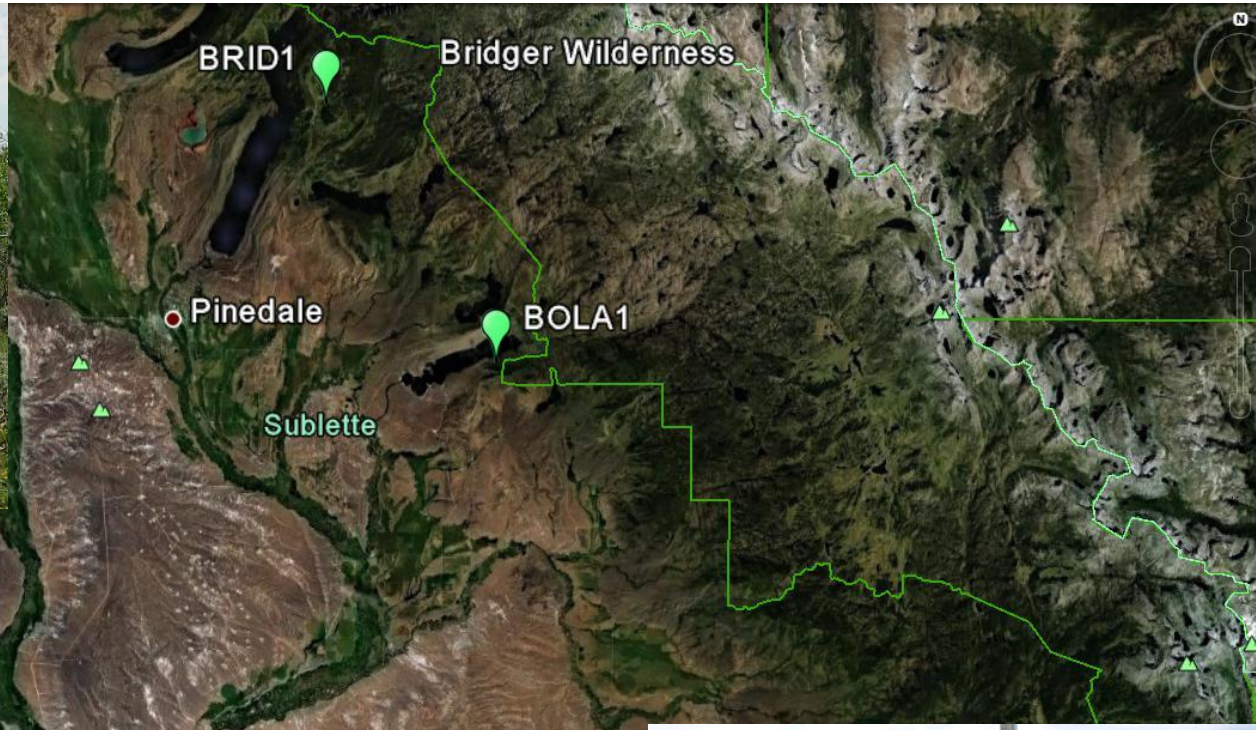
- ✓ Large, Complex Multi-Dimensional Data Sets
- ✓ All we can see is one cross section at a time.
- ✓ Excellent Data Collection
- ✓ Kudos to operators past and present.
- ✓ Confounding Factors
- ✓ Multiple source regions, protocol changes, etc.



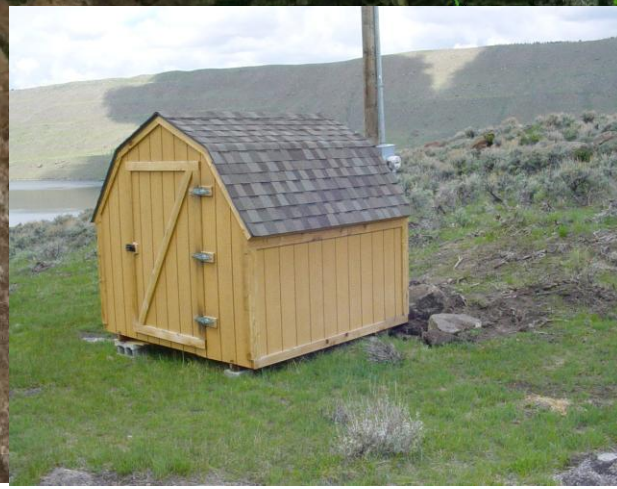
What We've Learned

- Progress at the BRID1 IMPROVE site in the context of the Regional Haze Rule has been mixed with somewhat lower nitrate concentrations measured along with somewhat higher sulfate concentrations compared to the baseline.
- The supplementary sampling done at the BOLA1 site demonstrates modest local impacts that are not captured at the BRID1 site. The differences between the two sites justify additional monitoring.
- Detailed emissions data would be necessary to link local impacts to nearby sources.

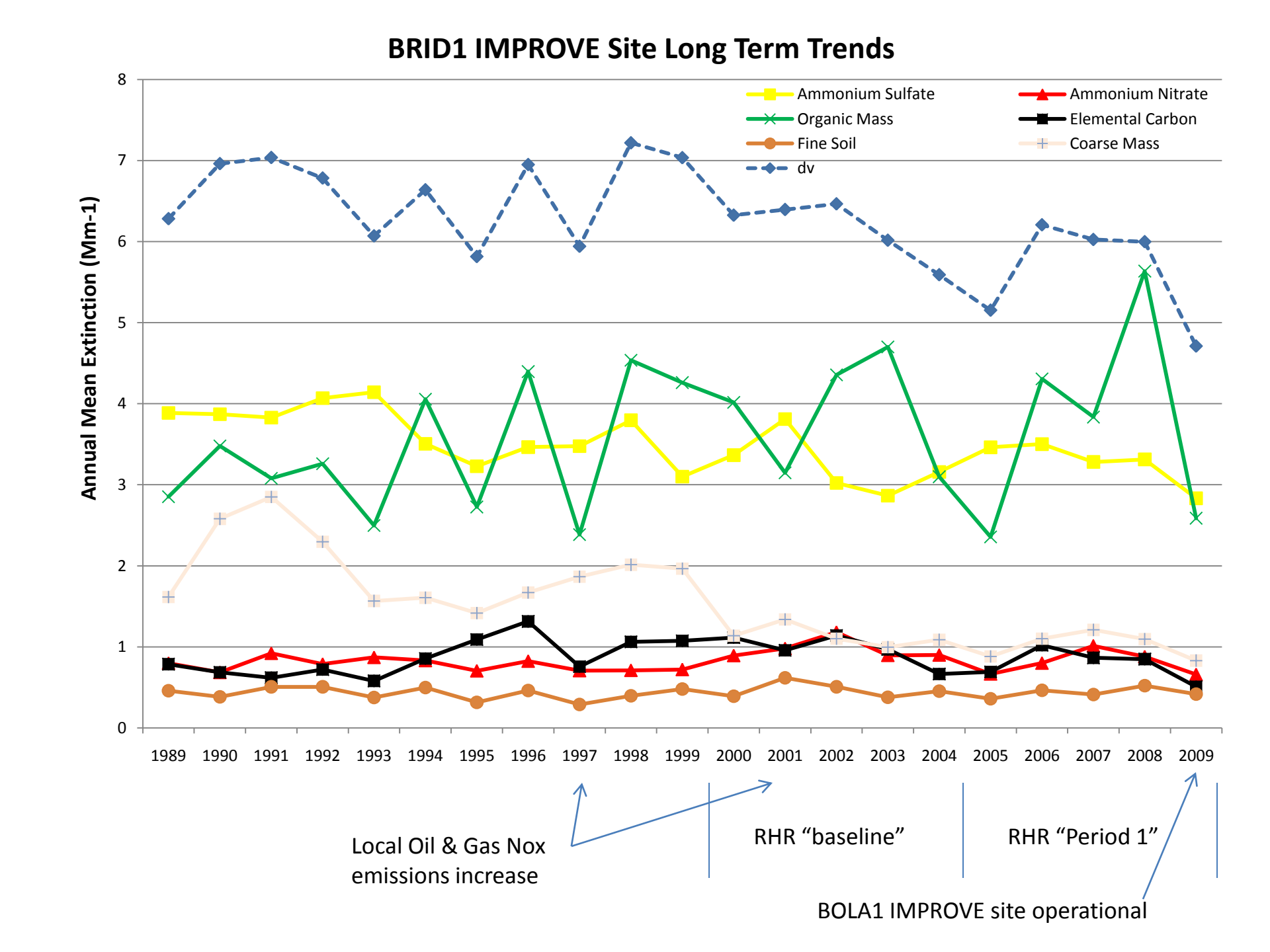



BRID1
Bridger Wilderness
Pinedale
BOLA1
Sublette

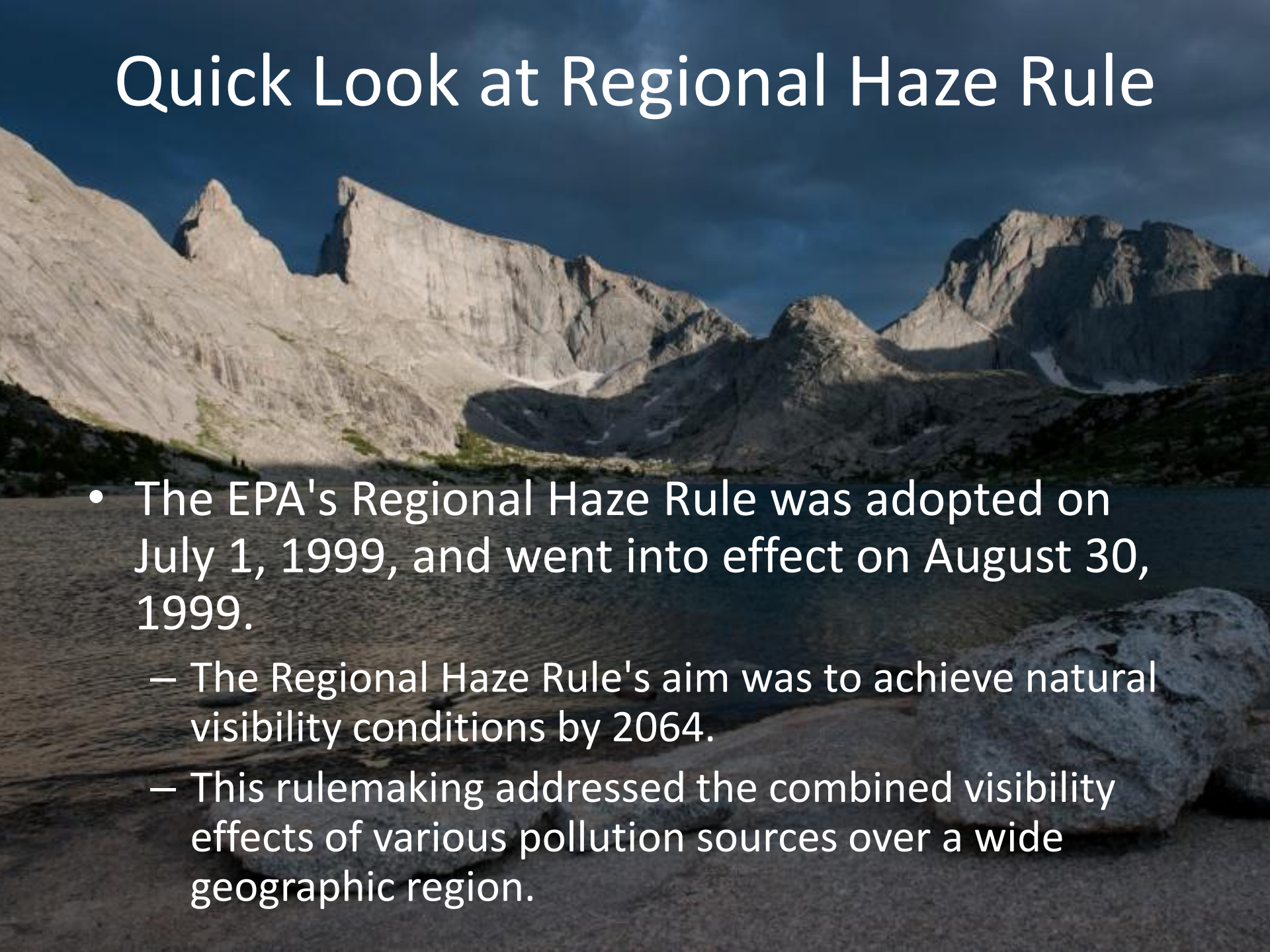

Big Piney
Image USDA Farm Service Agency
© 2011 Google
Image © 2011 DigitalGlobe
Imagery Date: 7/4/2009
lat 42.725459° lon -109.762171° elev 7085 ft




Sulfur Dioxide
Ammonium Sulfate
Nitrogen Dioxide
Ammonium Nitrate

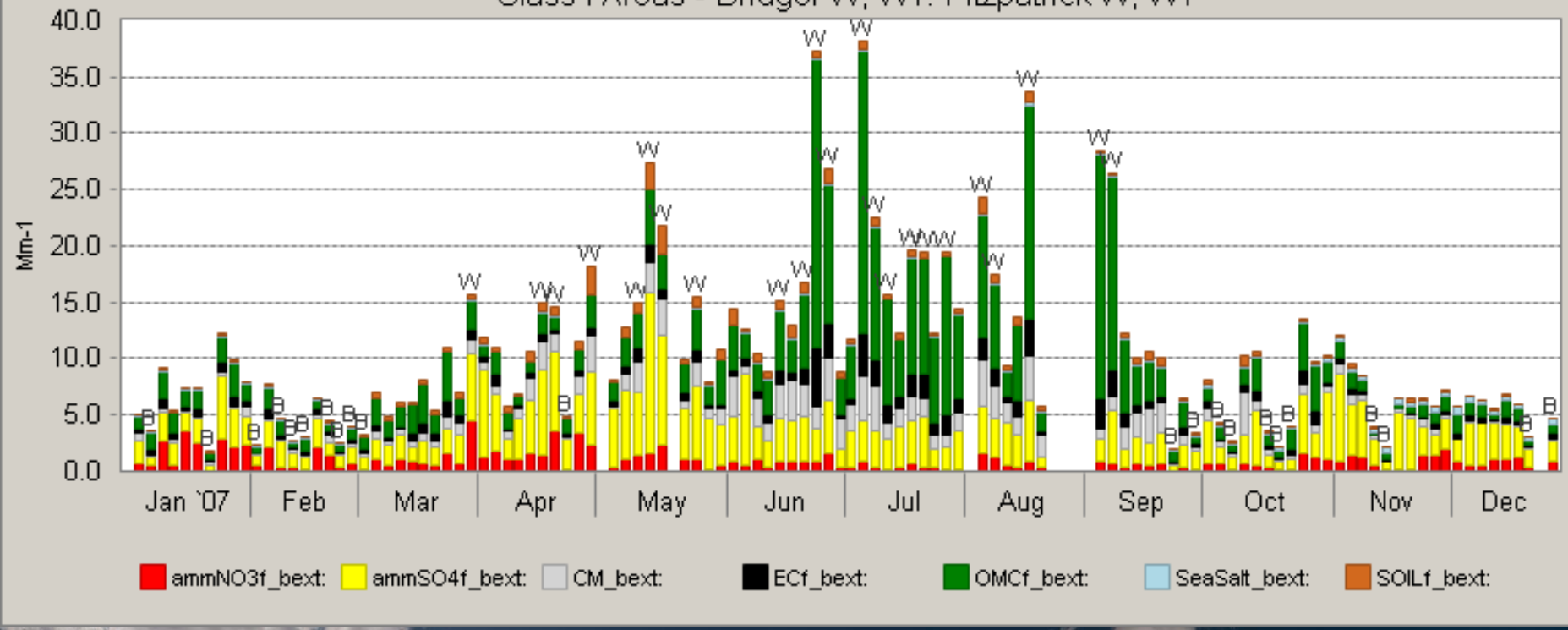

BRID1 IMPROVE Site Long Term Trends
Annual Mean Extinction (Mm-1)
0
1
2
3
4
5
6
7
8
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Ammonium Sulfate
Ammonium Nitrate
Organic Mass
Elemental Carbon
Fine Soil
Coarse Mass
dv
Local Oil & Gas Nox emissions increase
RHR "baseline"
RHR "Period 1"
BOLA1 IMPROVE site operational

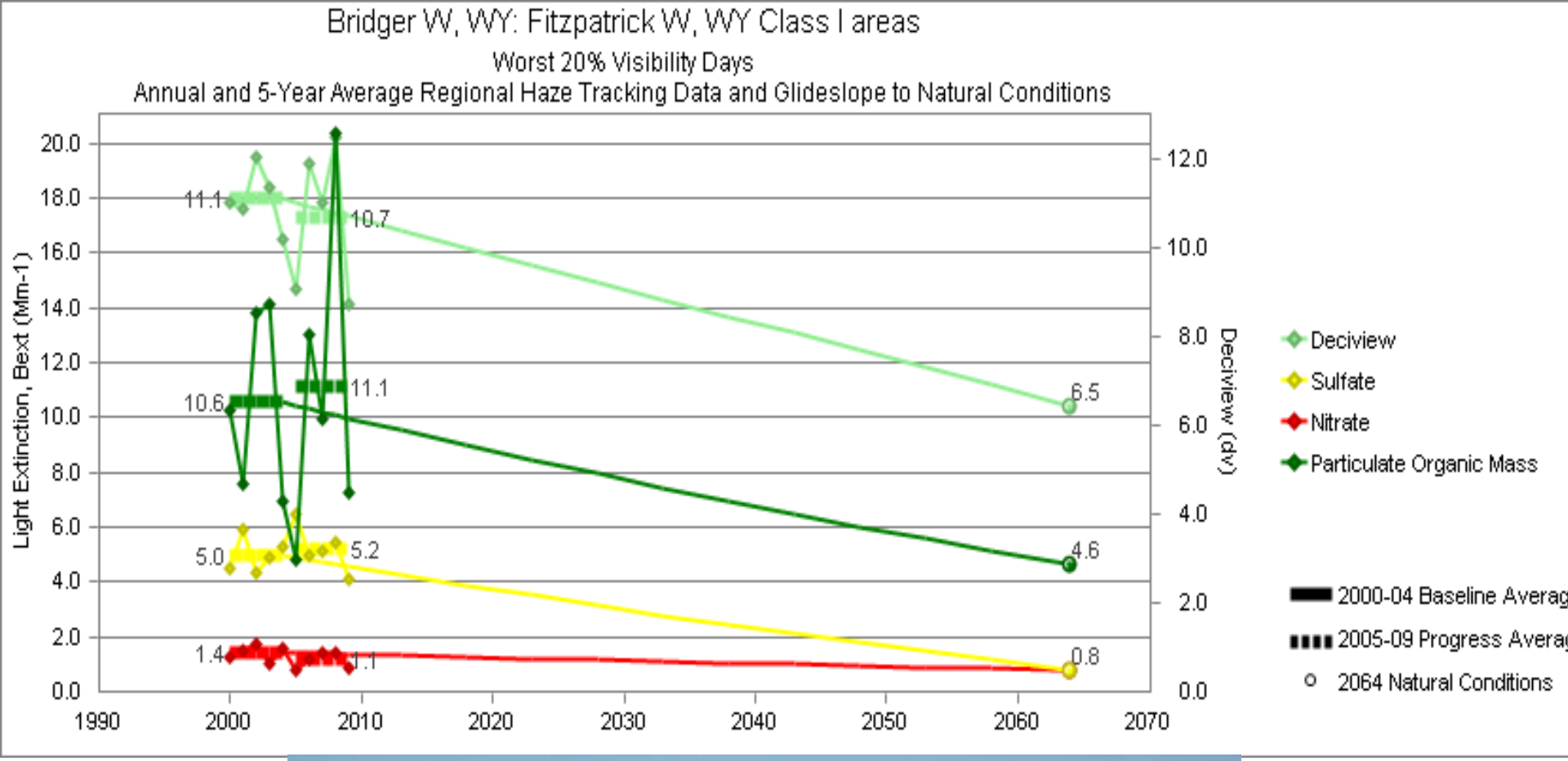
Quick Look at Regional Haze Rule

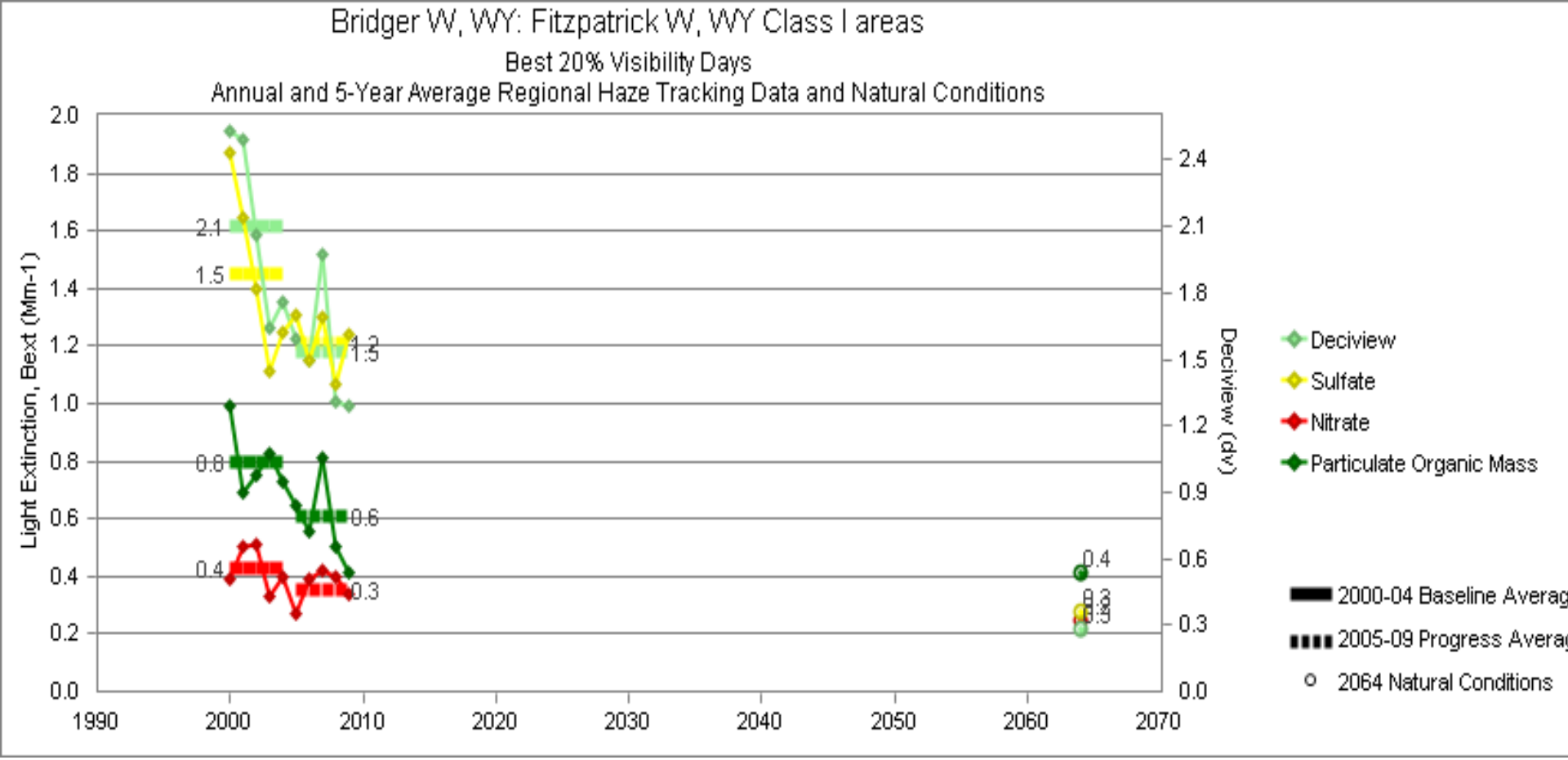


- The EPA's Regional Haze Rule was adopted on July 1, 1999, and went into effect on August 30, 1999.
  - The Regional Haze Rule's aim was to achieve natural visibility conditions by 2064.
  - This rulemaking addressed the combined visibility effects of various pollution sources over a wide geographic region.

BRID1

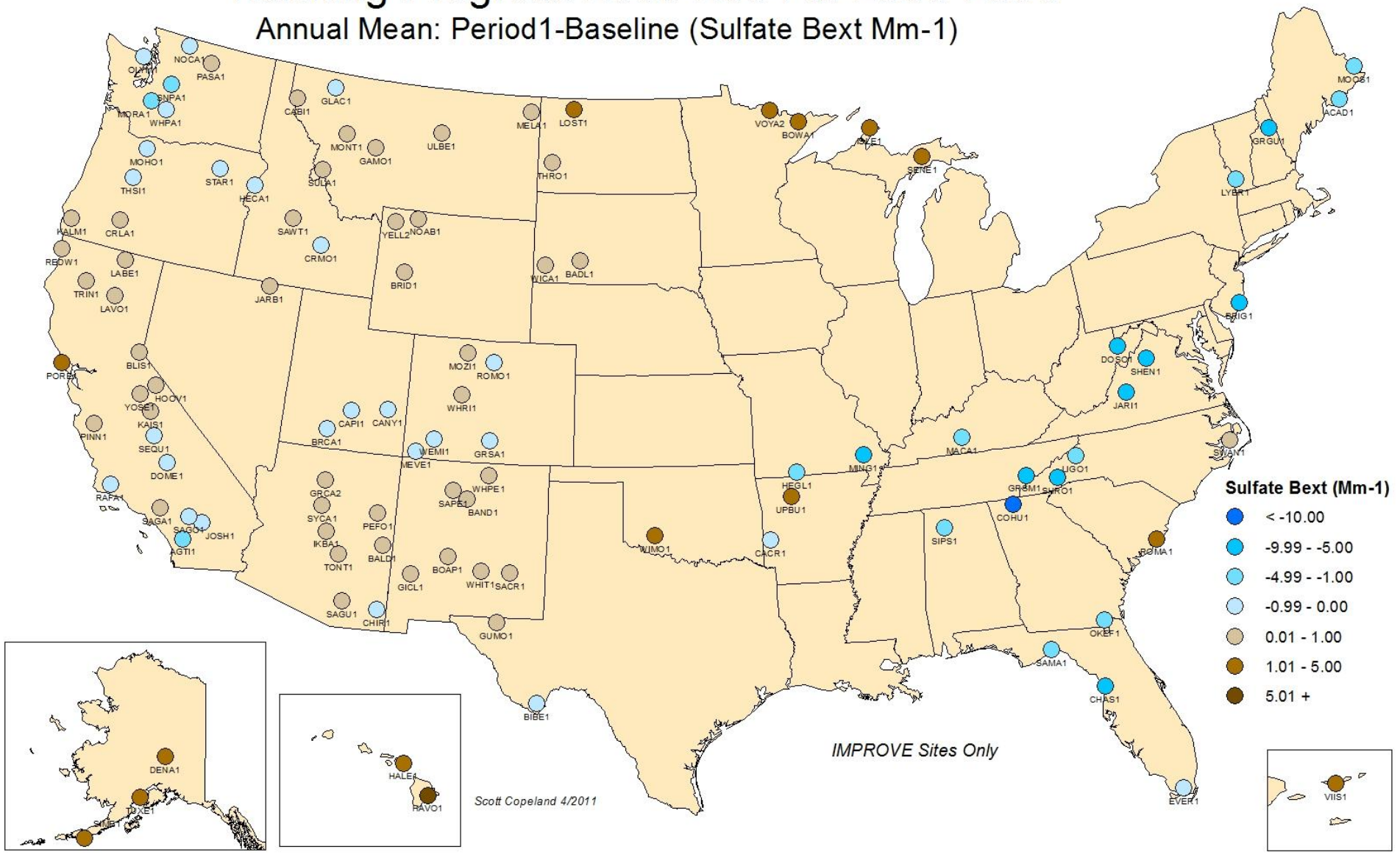

Class I Areas - Bridger W, WY: Fitzpatrick W, WY
Mm-1
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Jan `07
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
ammNO3f_bext:
ammSO4f_bext:
CM_bext:
ECf_bext:
OMCf_bext:
SeaSalt_bext:
SOILf_bext:


Bridger W, WY: Fitzpatrick W, WY Class I areas
Worst 20% Visibility Days
Annual and 5-Year Average Regional Haze Tracking Data and Glideslope to Natural Conditions
Light Extinction, Bext (Mm-1)
Deciview (dv)
11.1
10.7
10.6
11.1
5.0
5.2
1.4
1.1
6.5
4.6
0.8
Deciview
Sulfate
Nitrate
Particulate Organic Mass
2000-04 Baseline Averag
2005-09 Progress Averag
2064 Natural Conditions


Bridger W, WY: Fitzpatrick W, WY Class I areas
Best 20% Visibility Days
Annual and 5-Year Average Regional Haze Tracking Data and Natural Conditions
Light Extinction, Bext (Mm-1)
Deciview (dv)
2.1
1.5
1.2
1.5
0.8
0.6
0.4
0.3
0.4
Deciview
Sulfate
Nitrate
Particulate Organic Mass
2000-04 Baseline Averag
2005-09 Progress Averag
2064 Natural Conditions

Tracking Progress 2000-2004 to 2005-2009

Annual Mean: Period1-Baseline (Sulfate Bext Mm-1)



Sulfate Bext (Mm-1)

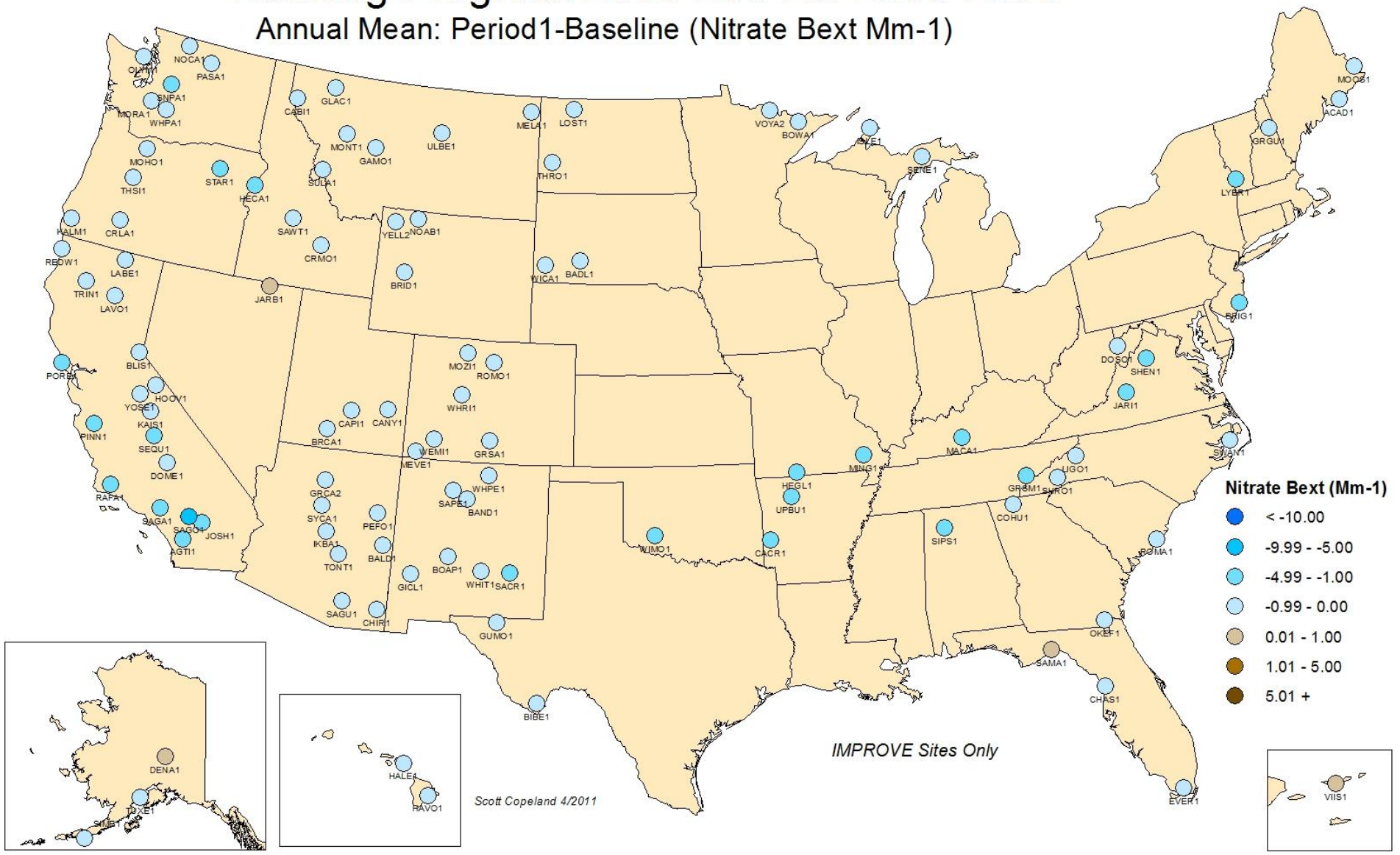
- < -10.00
- -9.99 - -5.00
- -4.99 - -1.00
- -0.99 - 0.00
- 0.01 - 1.00
- 1.01 - 5.00
- 5.01 +

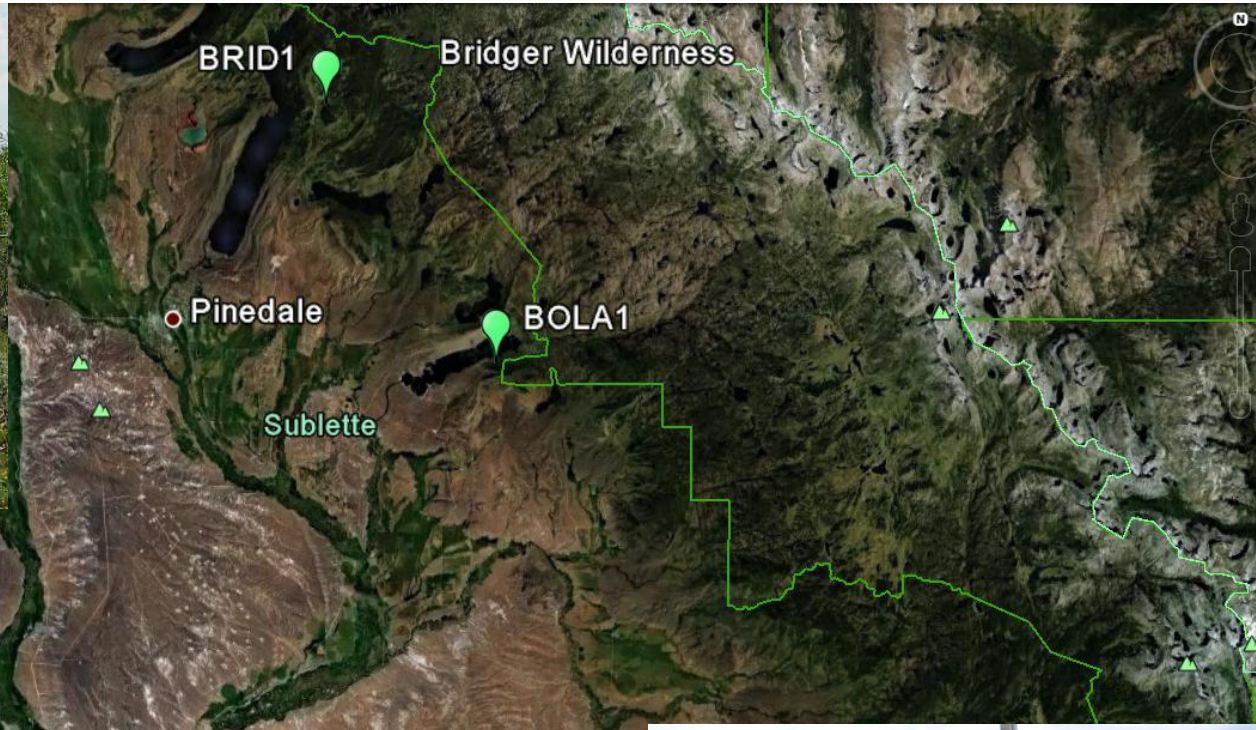
IMPROVE Sites Only

Scott Copeland 4/2011

Tracking Progress 2000-2004 to 2005-2009

Annual Mean: Period1-Baseline (Nitrate Bext Mm-1)

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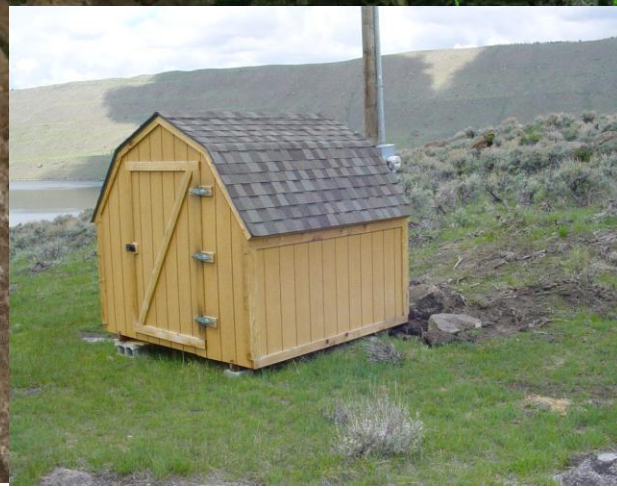
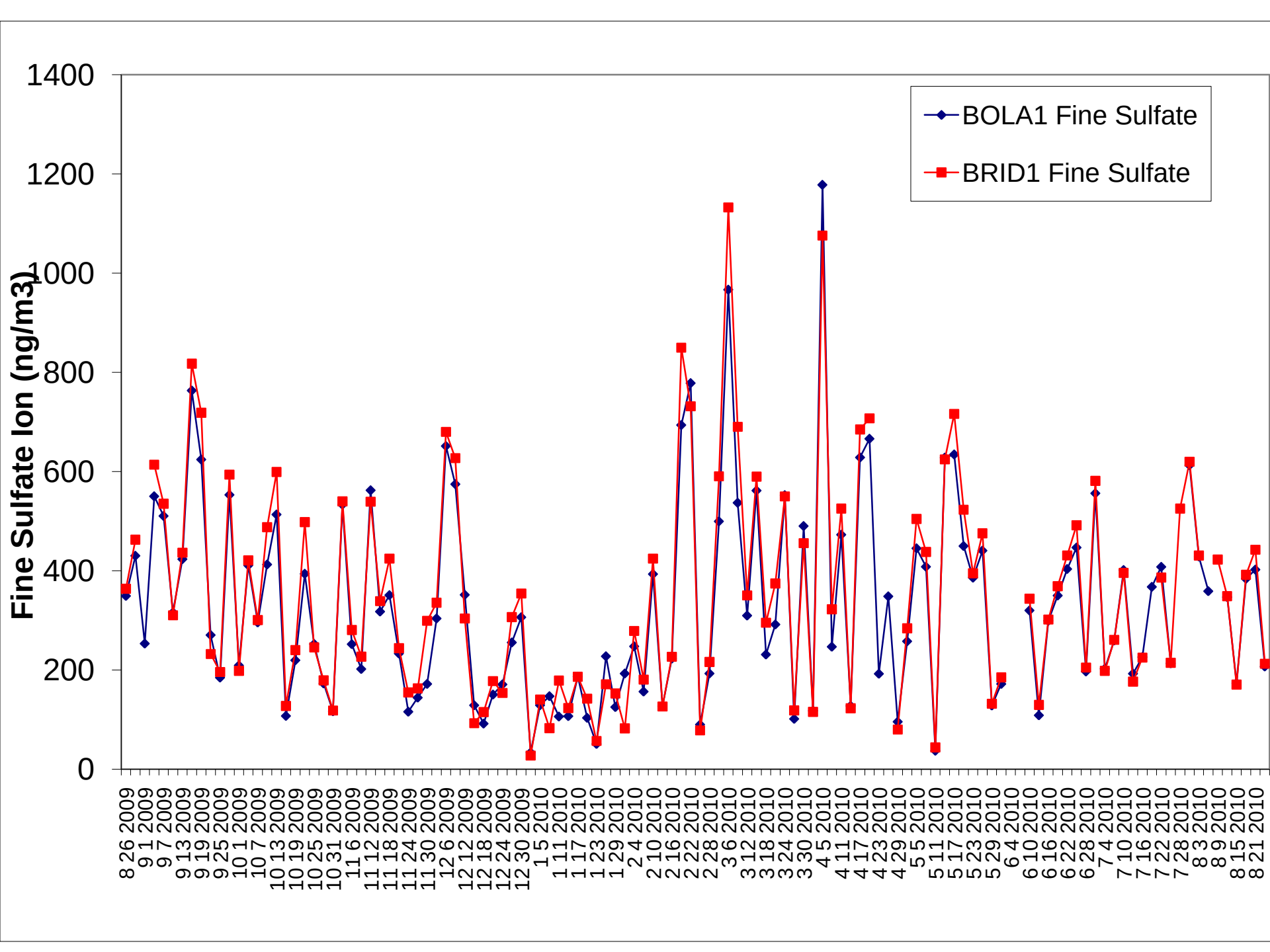
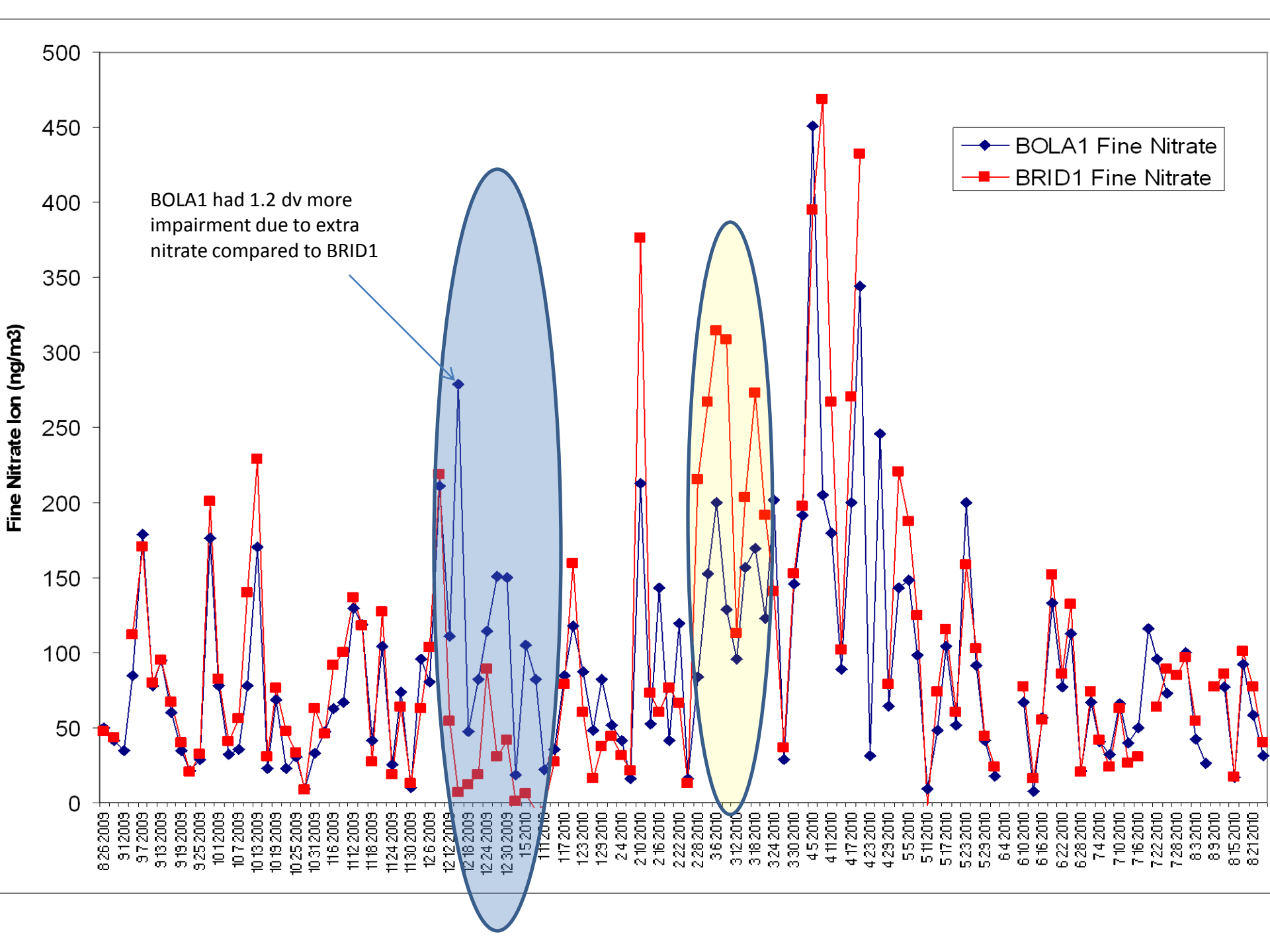
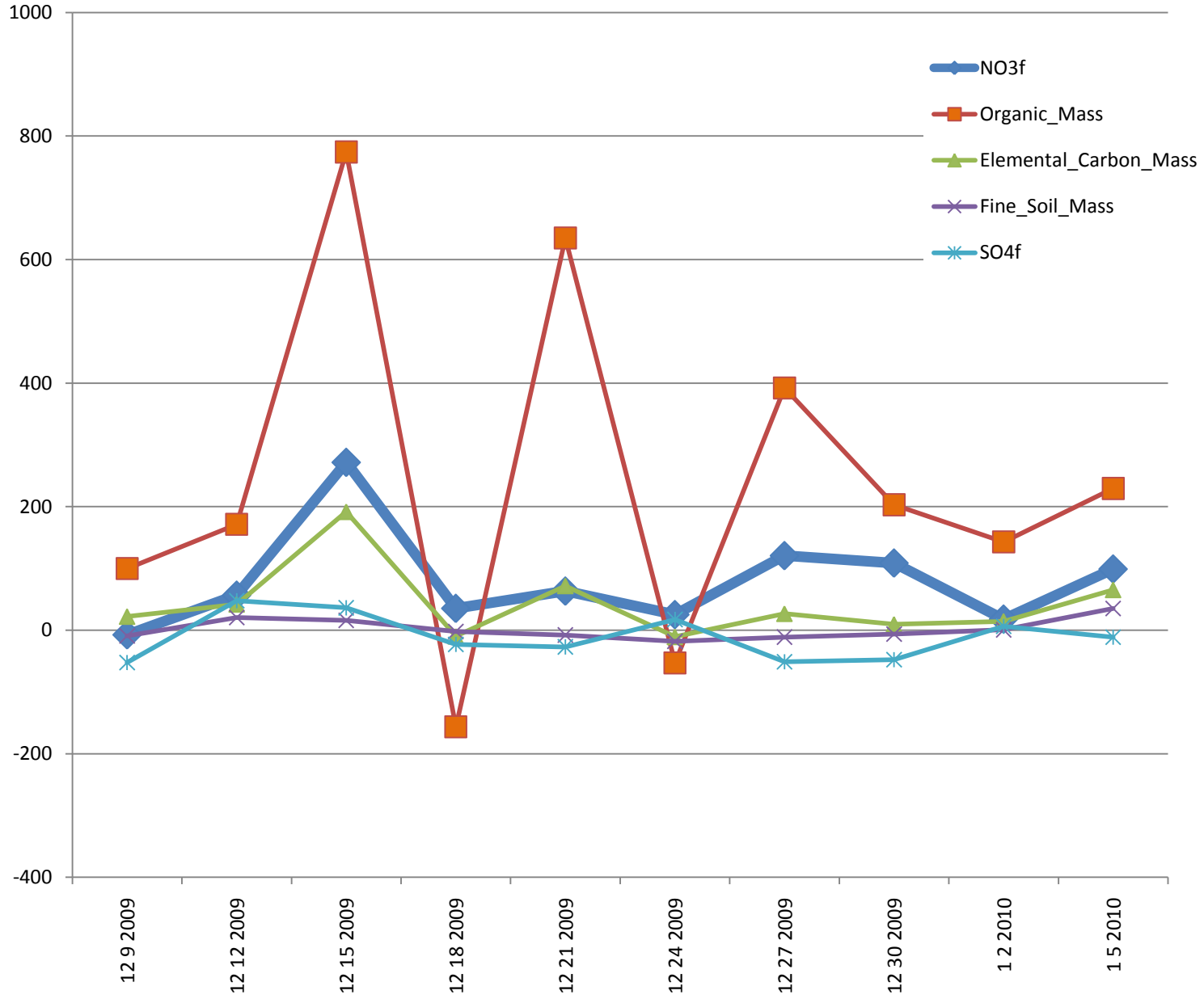


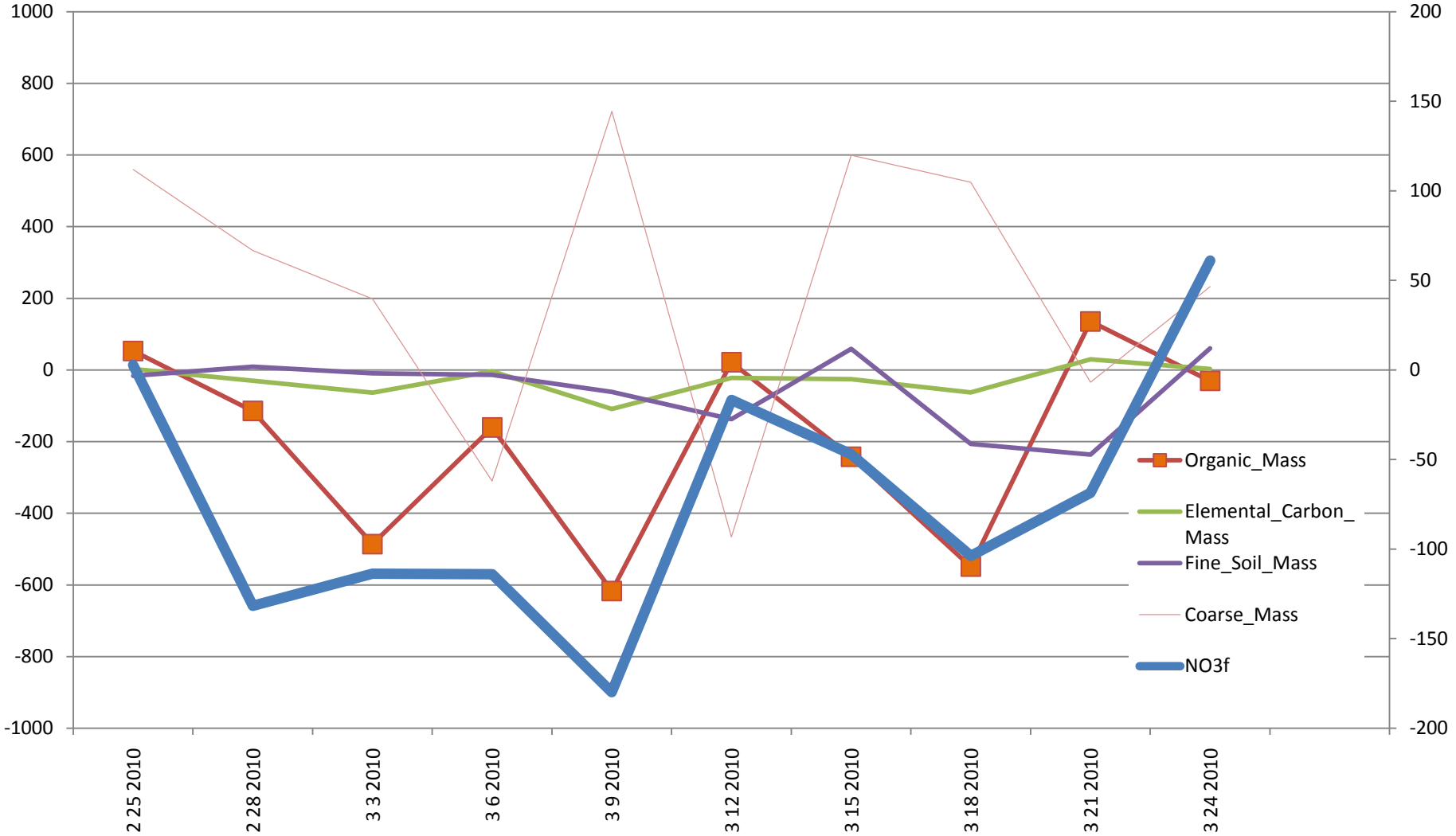

Fine Sulfate Ion (ng/m3)
1400
1200
1000
800
600
400
200
0
BOLA1 Fine Sulfate
BRID1 Fine Sulfate
8 26 2009
9 1 2009
9 7 2009
9 13 2009
9 19 2009
9 25 2009
10 1 2009
10 7 2009
10 13 2009
10 19 2009
10 25 2009
10 31 2009
11 6 2009
11 12 2009
11 18 2009
11 24 2009
11 30 2009
12 6 2009
12 12 2009
12 18 2009
12 24 2009
12 30 2009
1 5 2010
1 11 2010
1 17 2010
1 23 2010
1 29 2010
2 4 2010
2 10 2010
2 16 2010
2 22 2010
2 28 2010
3 6 2010
3 12 2010
3 18 2010
3 24 2010
3 30 2010
4 5 2010
4 11 2010
4 17 2010
4 23 2010
4 29 2010
5 5 2010
5 11 2010
5 17 2010
5 23 2010
5 29 2010
6 4 2010
6 10 2010
6 16 2010
6 22 2010
6 28 2010
7 4 2010
7 10 2010
7 16 2010
7 22 2010
7 28 2010
8 3 2010
8 9 2010
8 15 2010
8 21 2010


BOLA1 had 1.2 dv more impairment due to extra nitrate compared to BRID1
BOLA1 Fine Nitrate
BRID1 Fine Nitrate
Fine Nitrate Ion (ng/m3)
500
450
400
350
300
250
200
150
100
50
0
8 26 2009
9 1 2009
9 7 2009
9 13 2009
9 19 2009
9 25 2009
10 1 2009
10 7 2009
10 13 2009
10 19 2009
10 25 2009
10 31 2009
11 6 2009
11 12 2009
11 18 2009
11 24 2009
11 30 2009
12 6 2009
12 12 2009
12 18 2009
12 24 2009
12 30 2009
1 5 2010
1 11 2010
1 17 2010
1 23 2010
1 29 2010
2 4 2010
2 10 2010
2 16 2010
2 22 2010
2 28 2010
3 6 2010
3 12 2010
3 18 2010
3 24 2010
3 30 2010
4 5 2010
4 11 2010
4 17 2010
4 23 2010
4 29 2010
5 5 2010
5 11 2010
5 17 2010
5 23 2010
5 29 2010
6 4 2010
6 10 2010
6 16 2010
6 22 2010
6 28 2010
7 4 2010
7 10 2010
7 16 2010
7 22 2010
7 28 2010
8 3 2010
8 9 2010
8 15 2010
8 21 2010

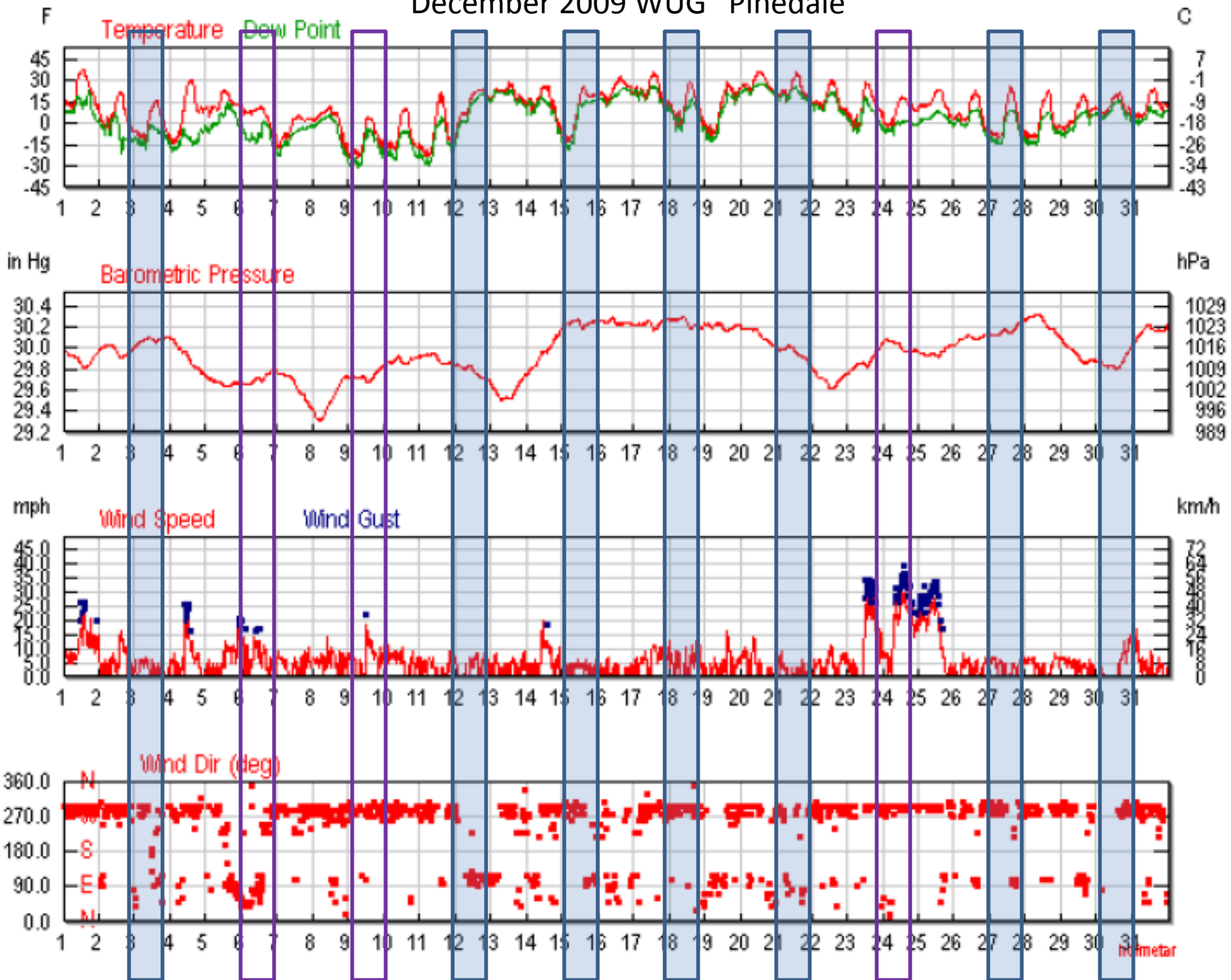
BOLA1 – BRID1 Select Species Concentrations



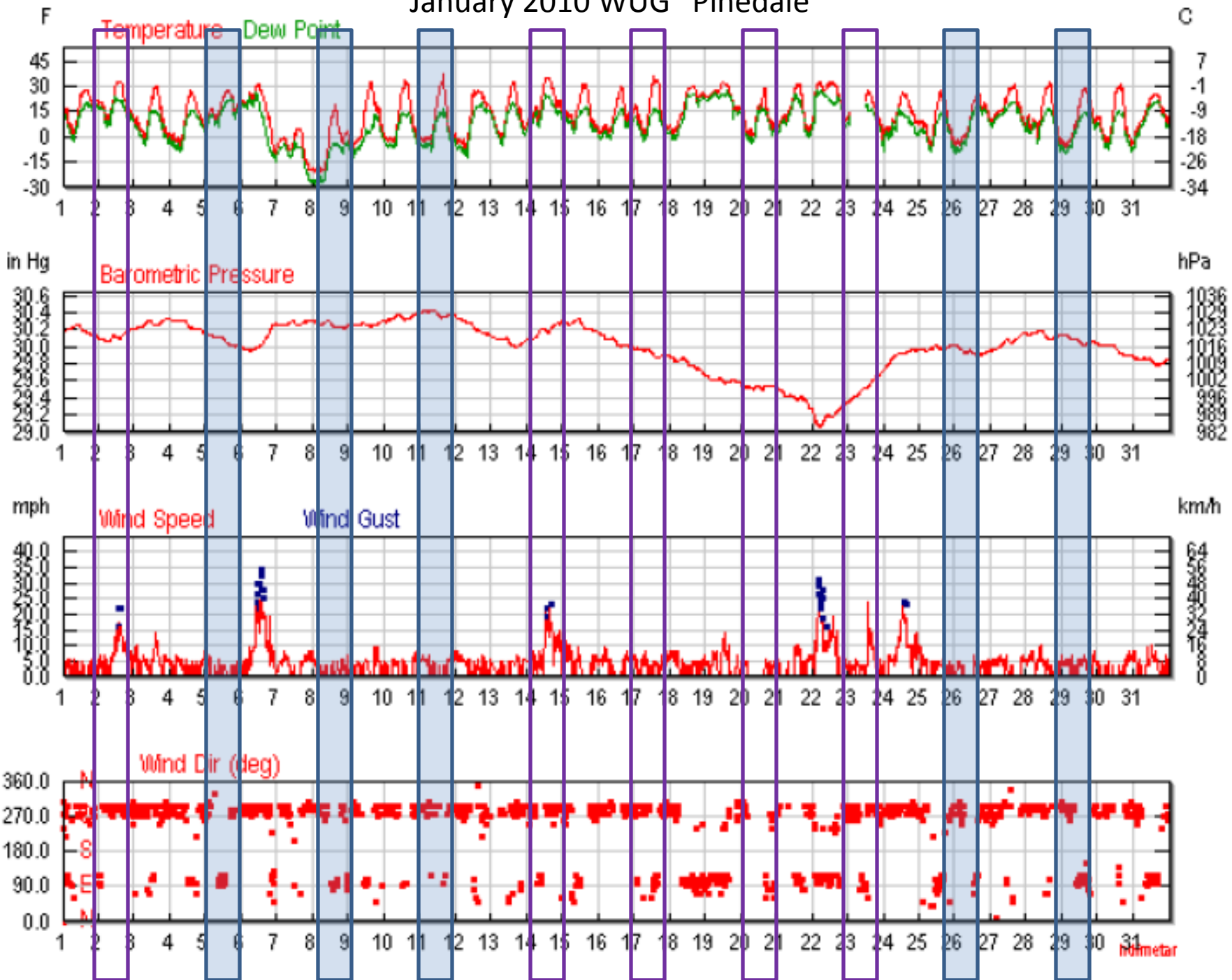
BOLA1 – BRID1 Select Species Concentrations



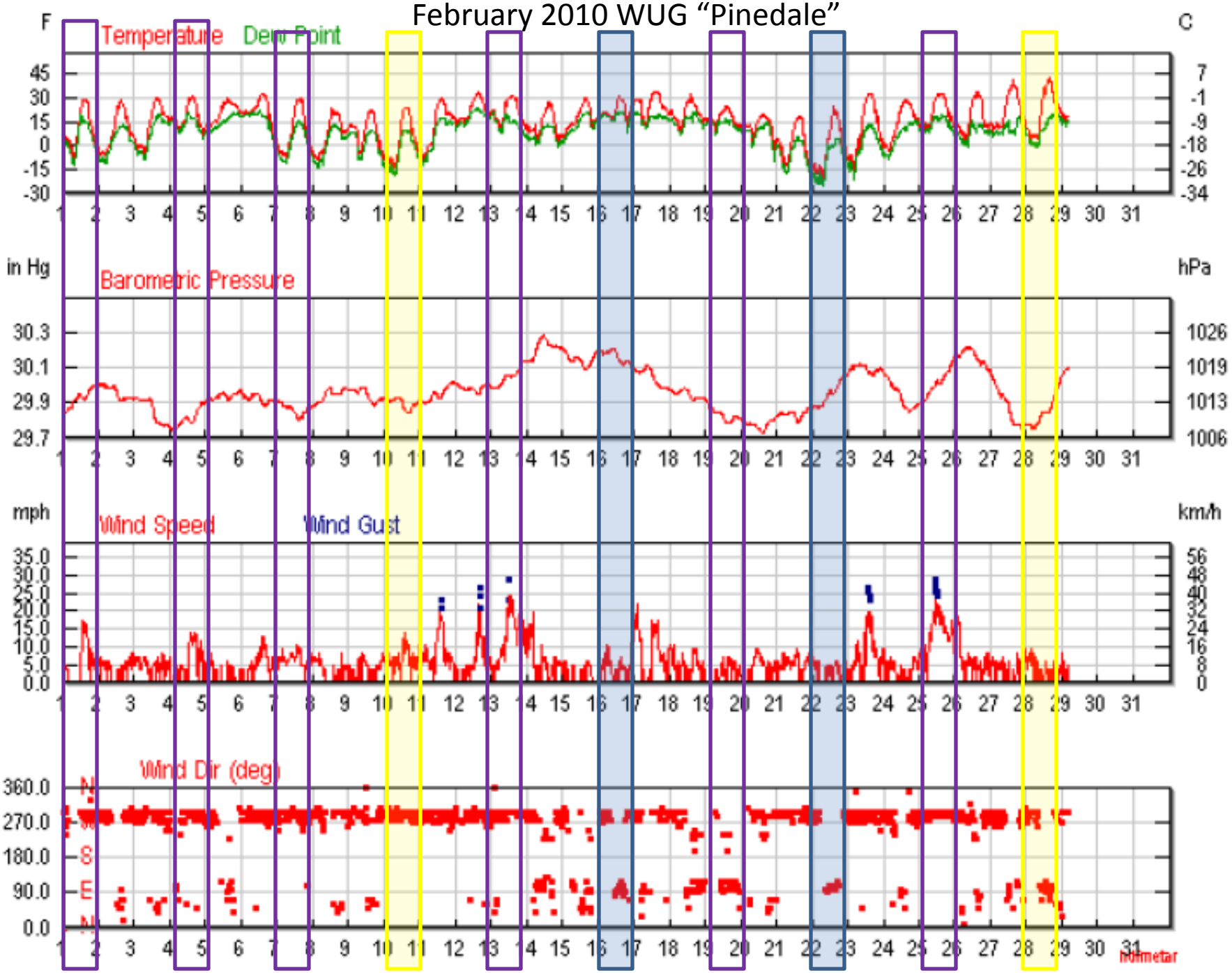
December 2009 WUG “Pinedale”



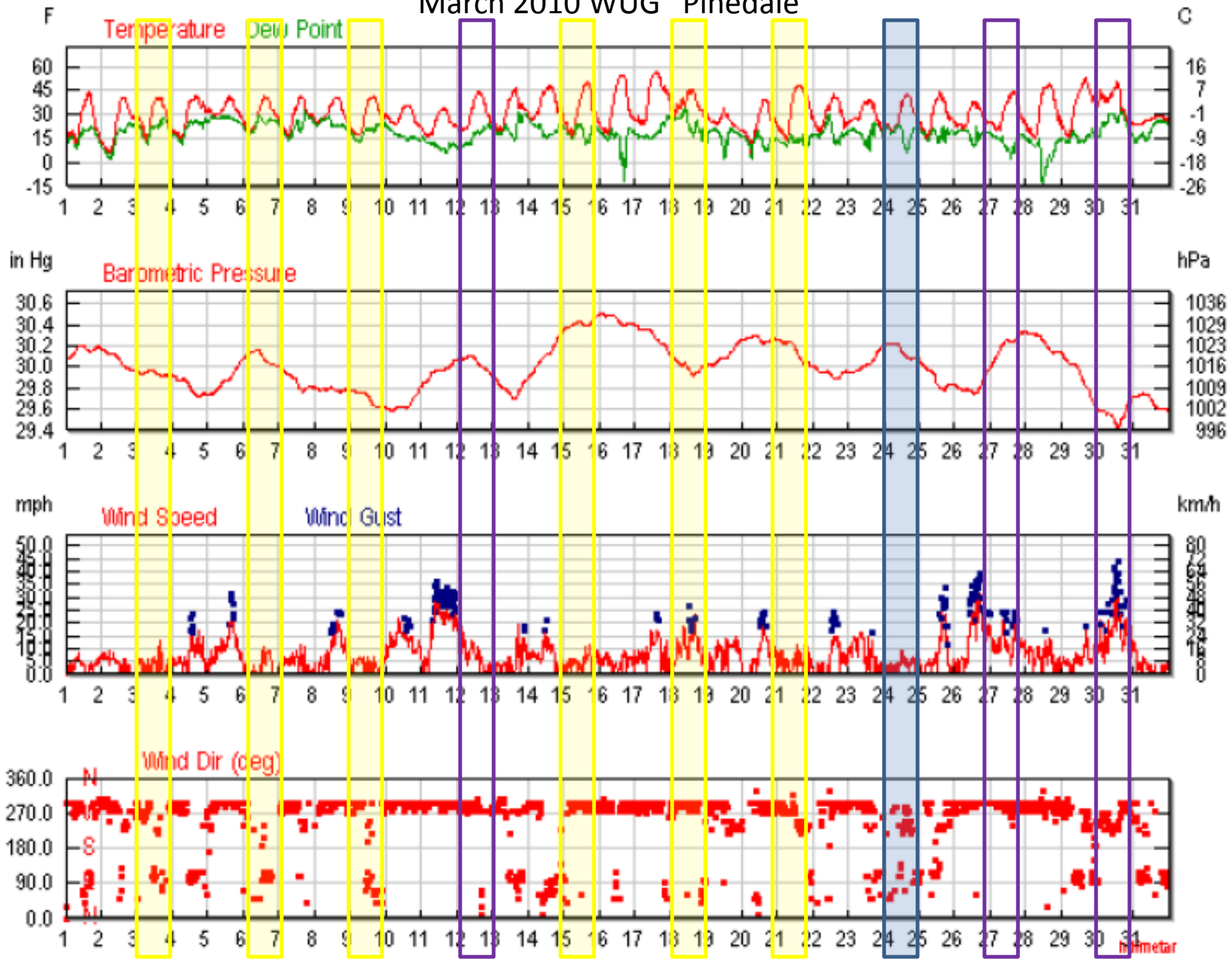
January 2010 WUG "Pinedale"

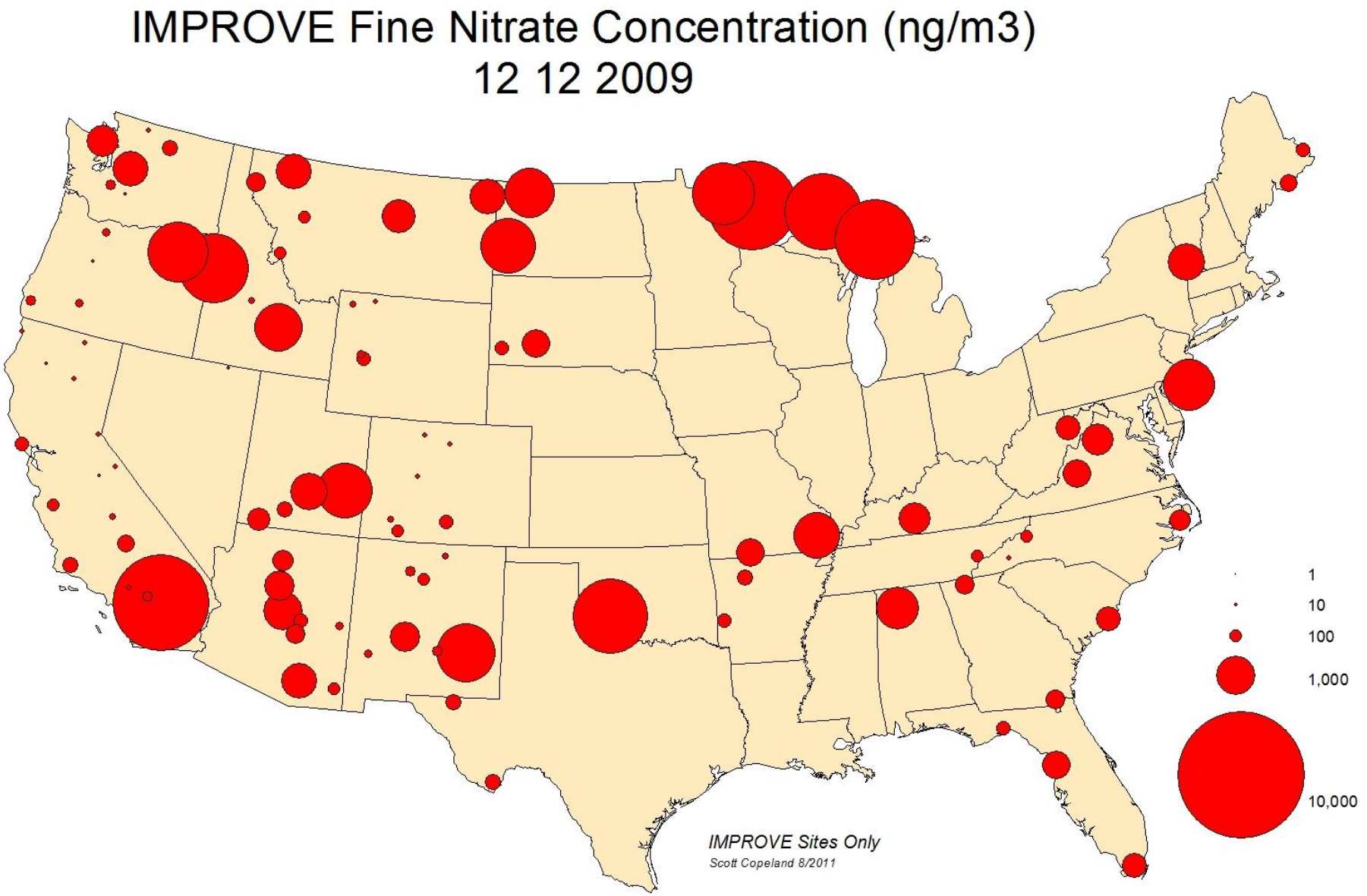


February 2010 WUG "Pinedale"

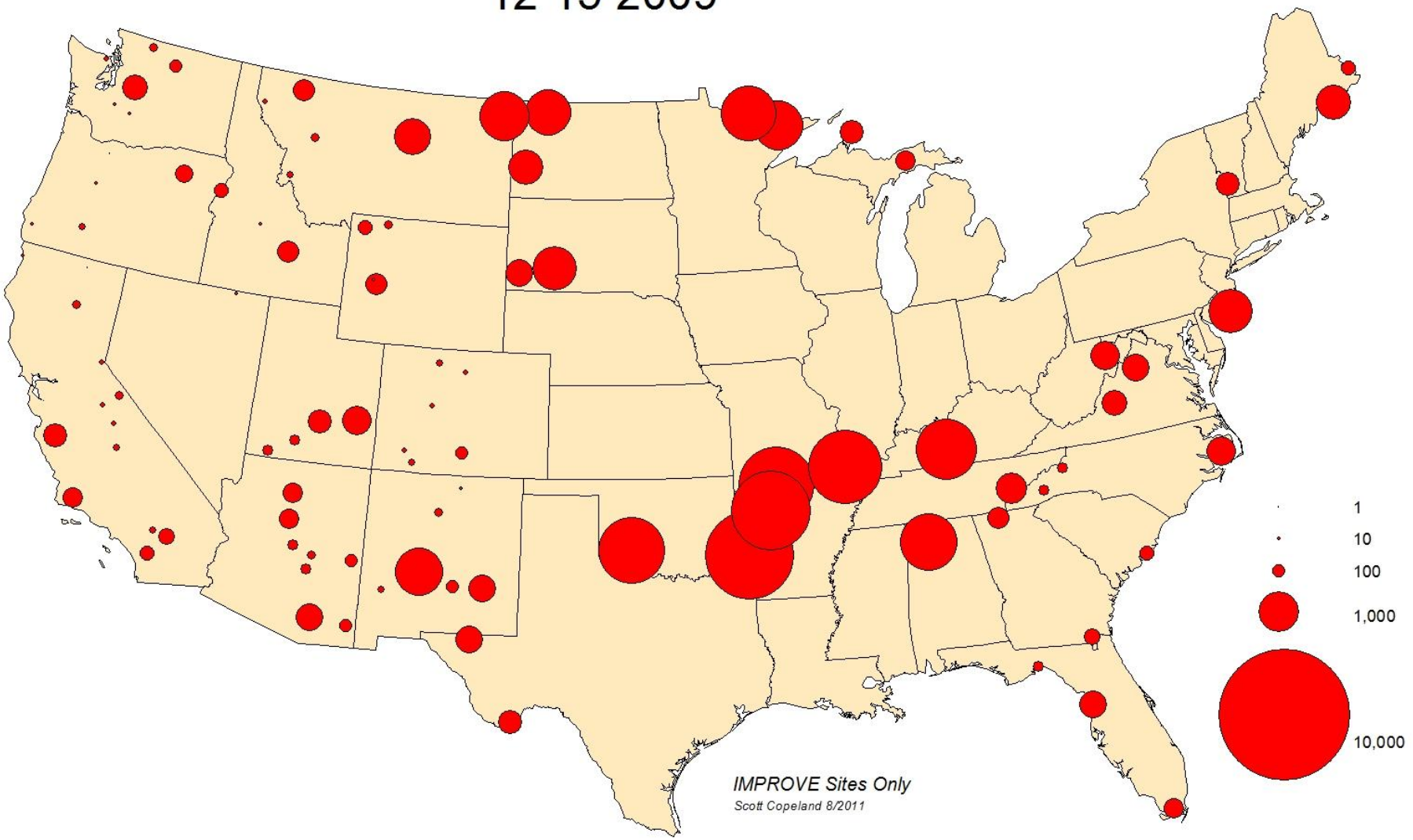


March 2010 WUG “Pinedale”





During winter separation episode, nitrate is different at the two sites, but modest compared to *some* western sites. During the same time period sulfate is nearly identical at the two sites, and changes with a much more regional pattern.



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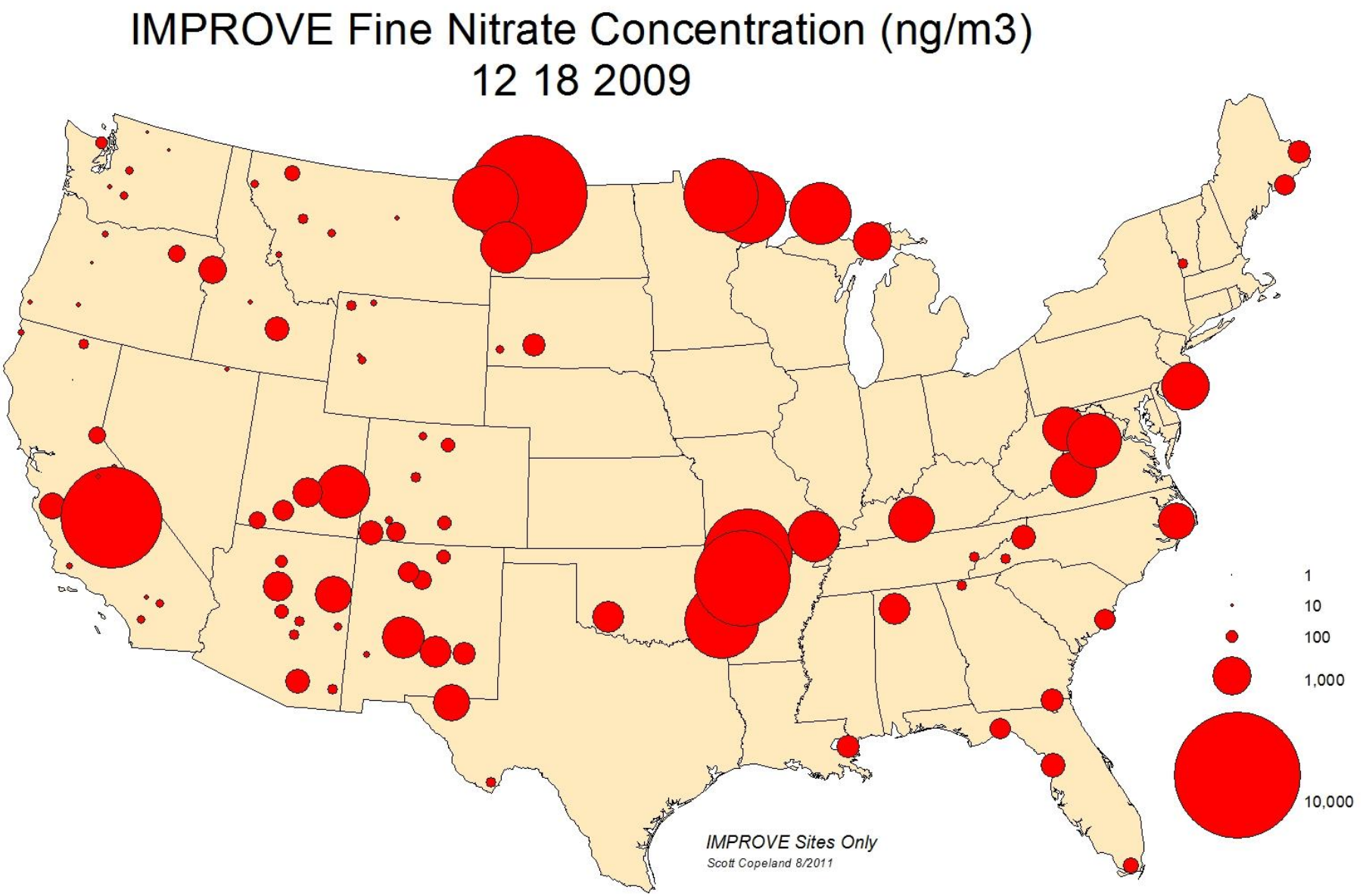

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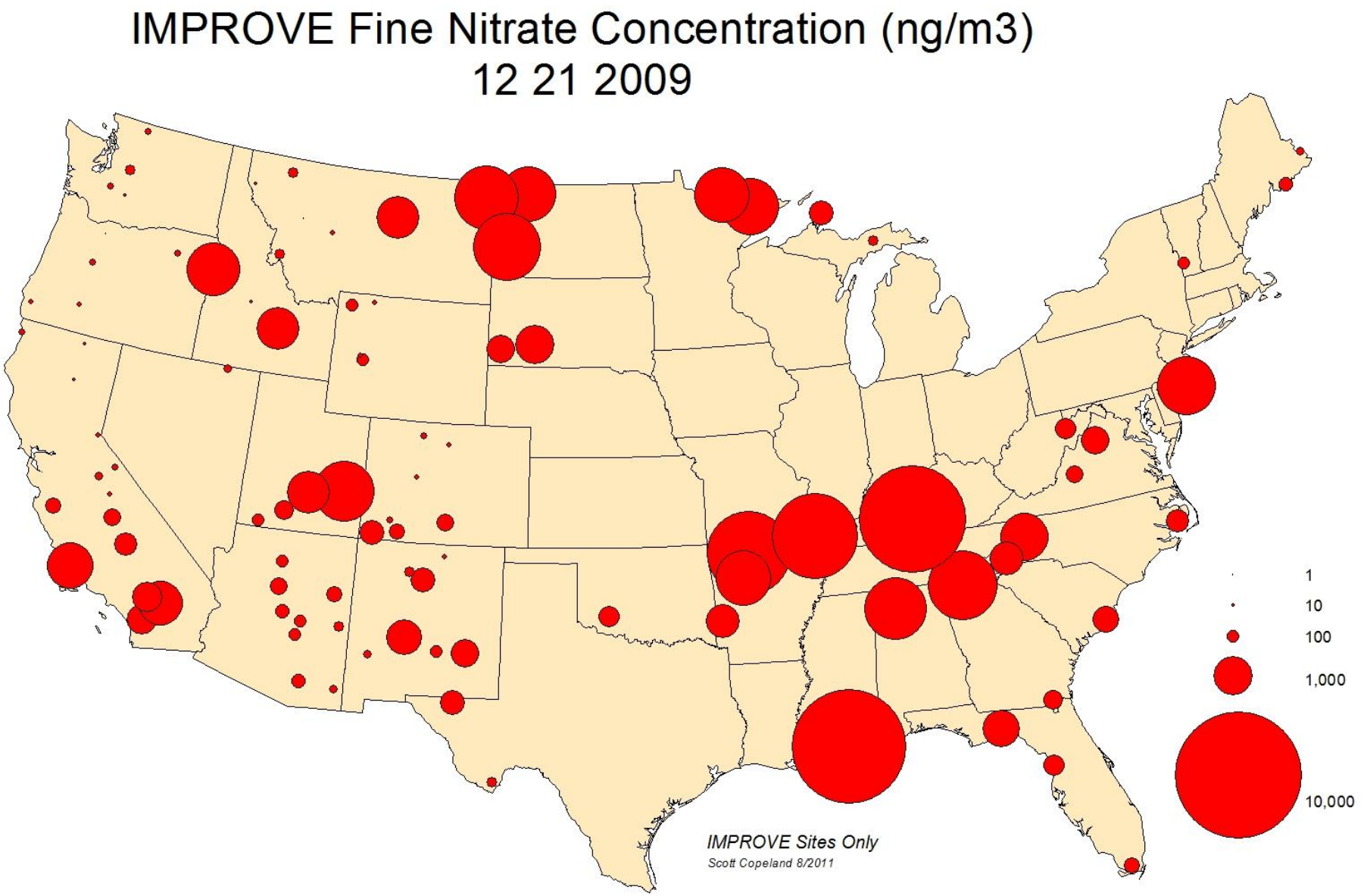

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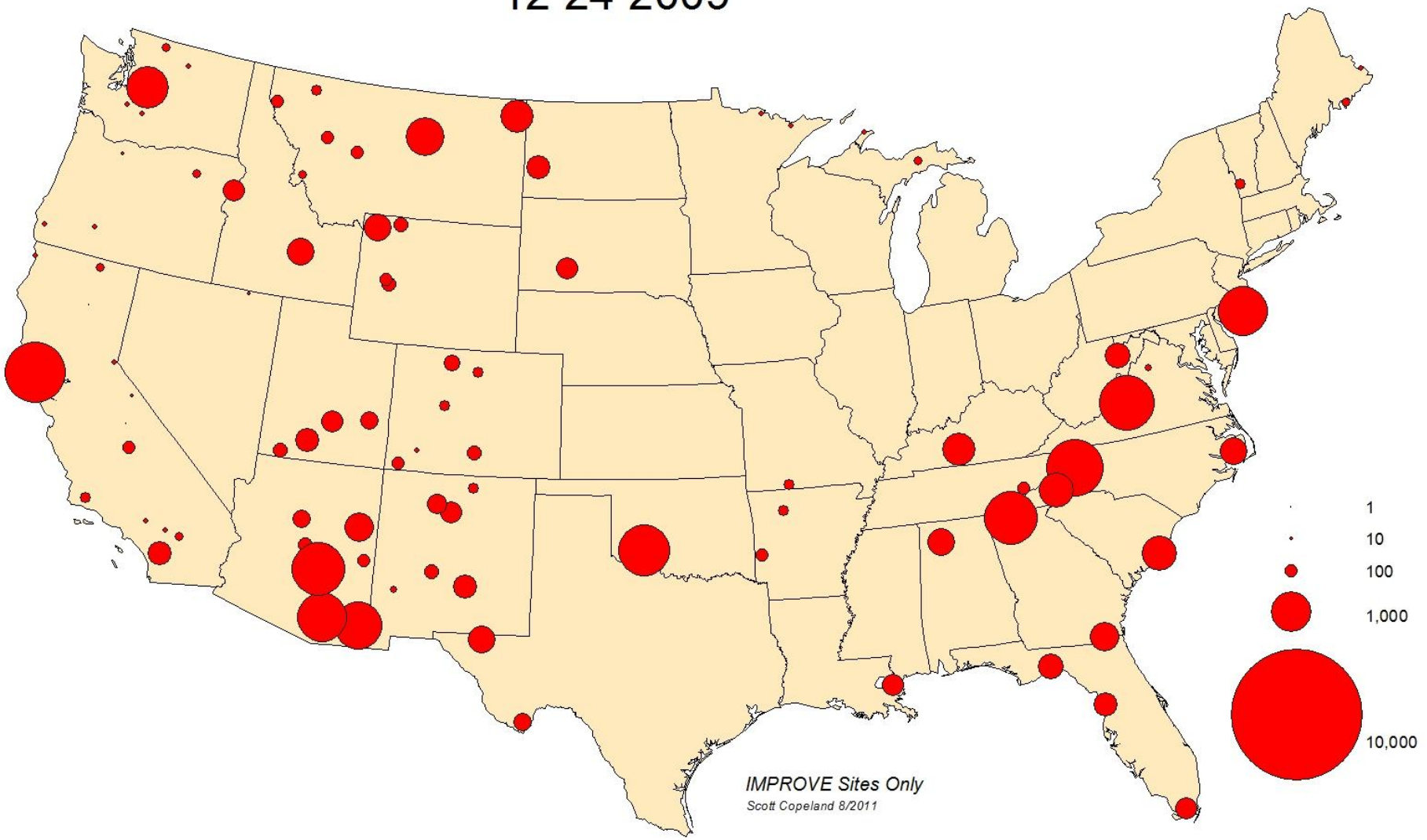

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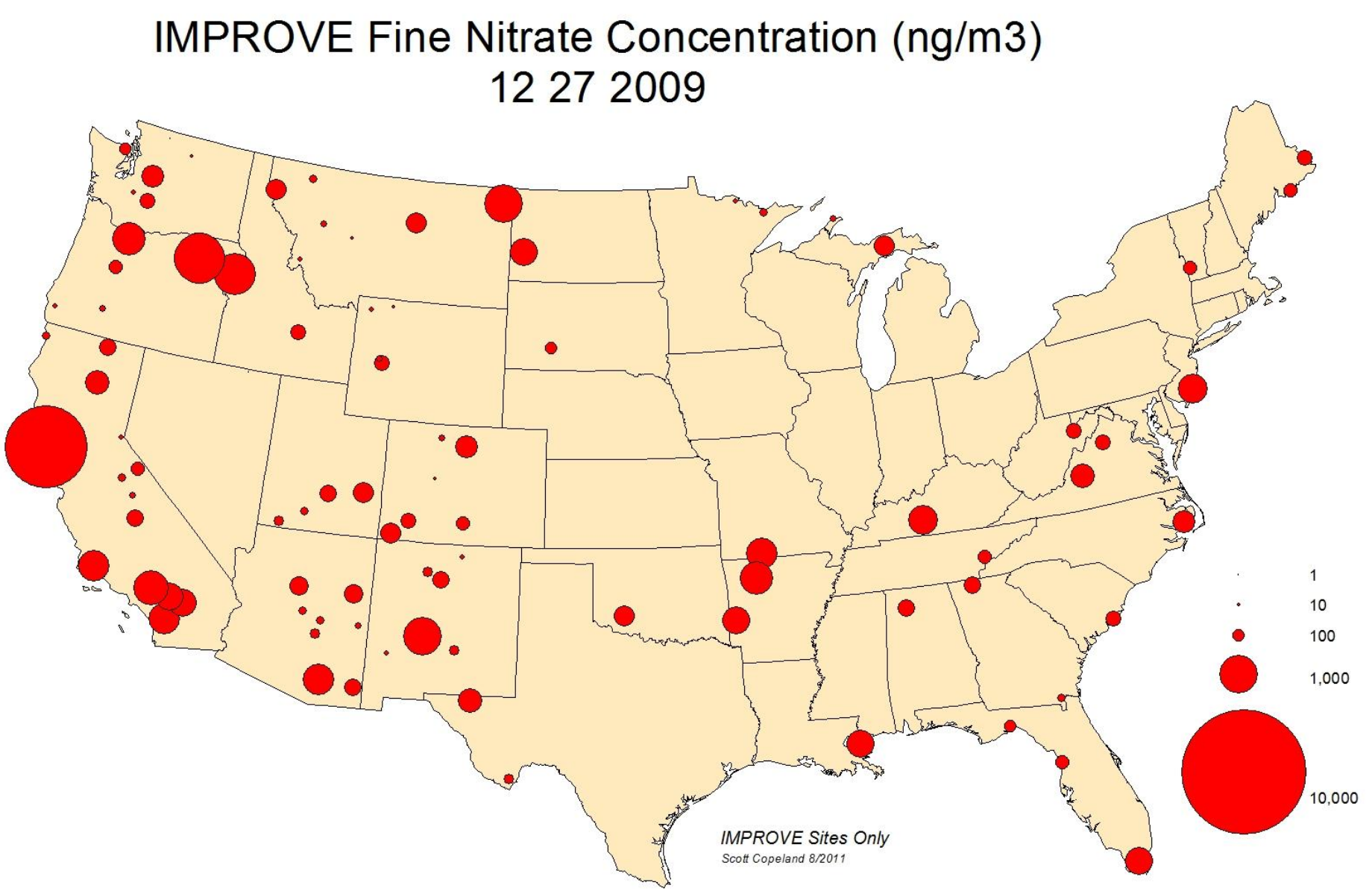

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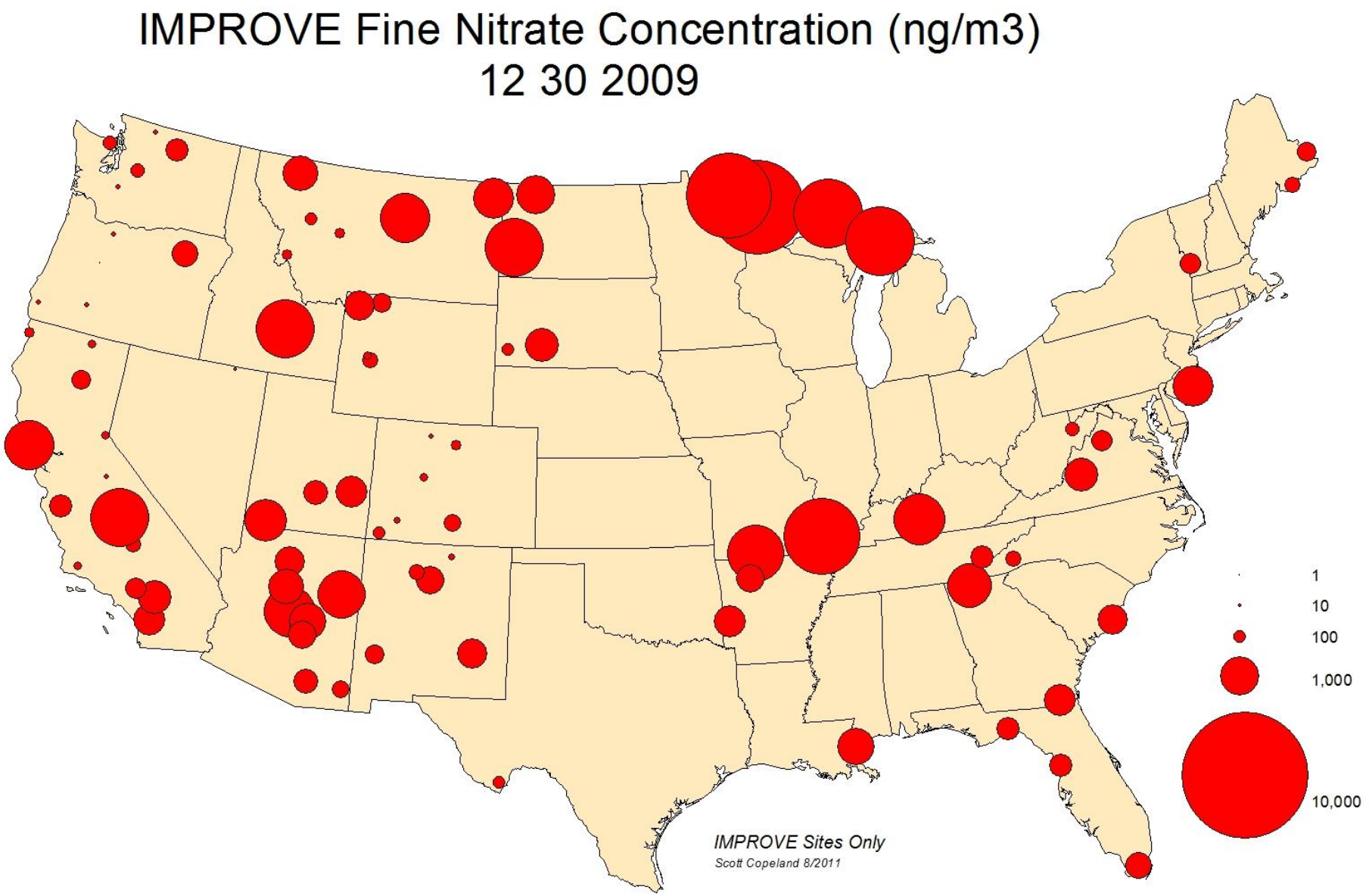

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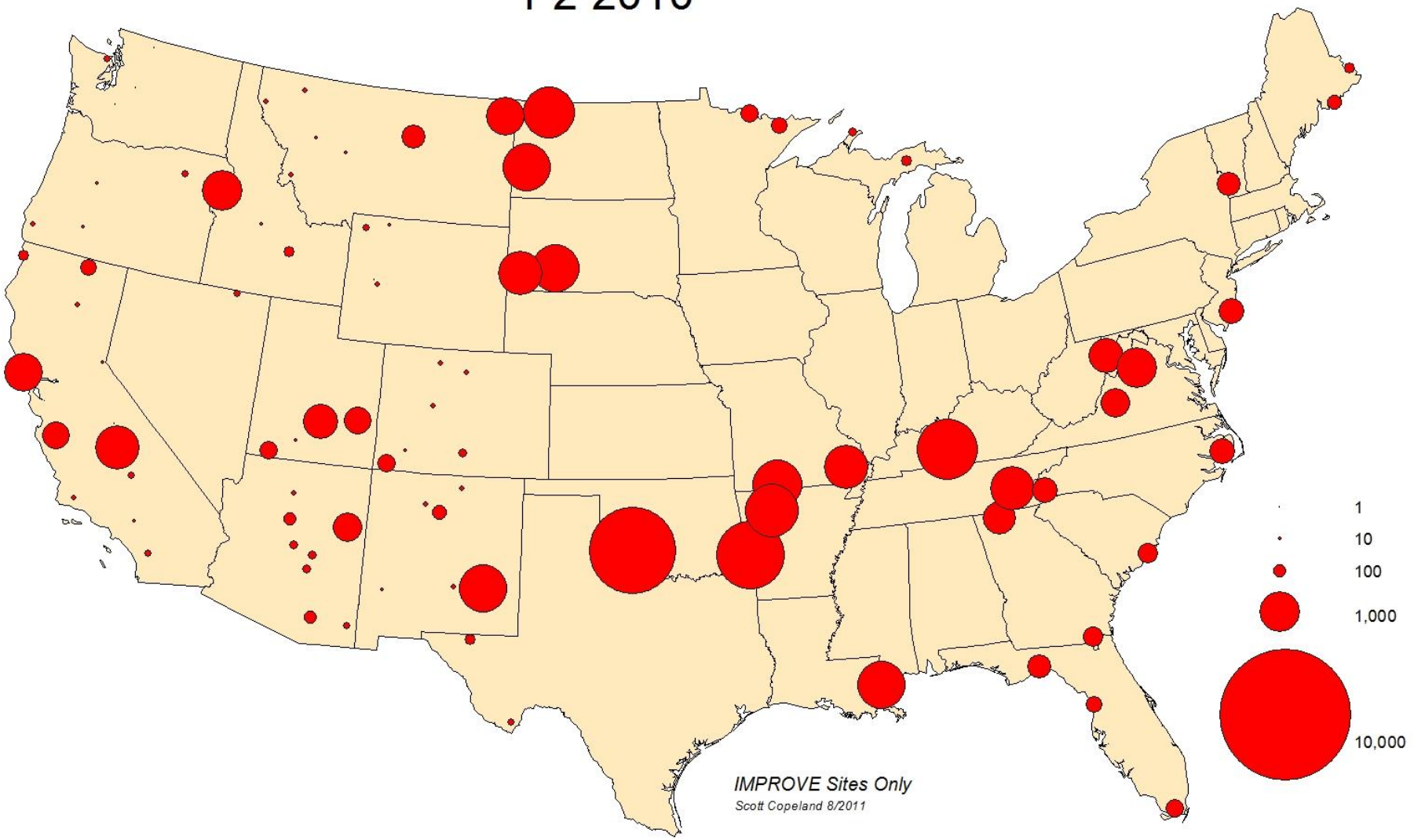

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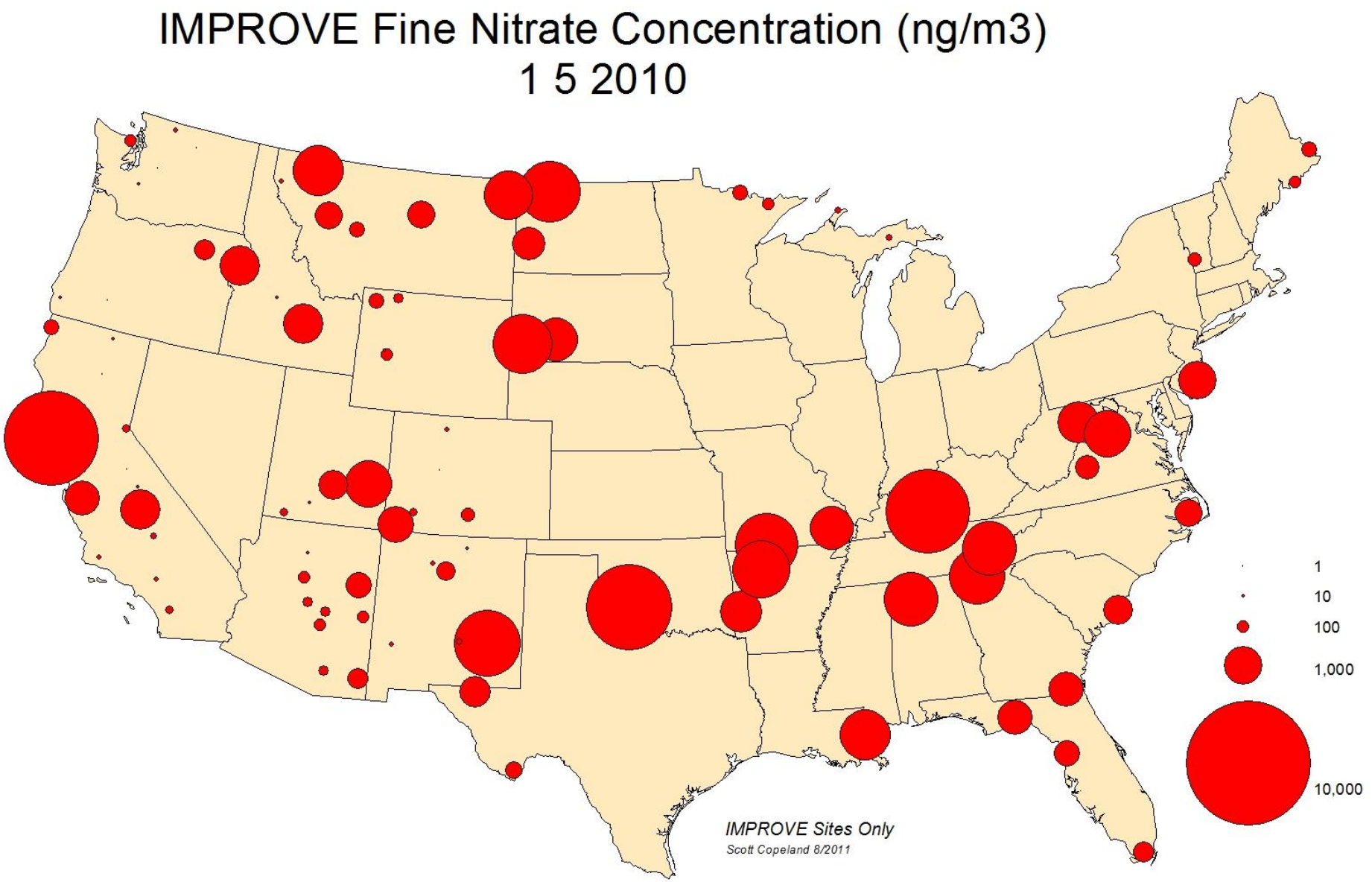

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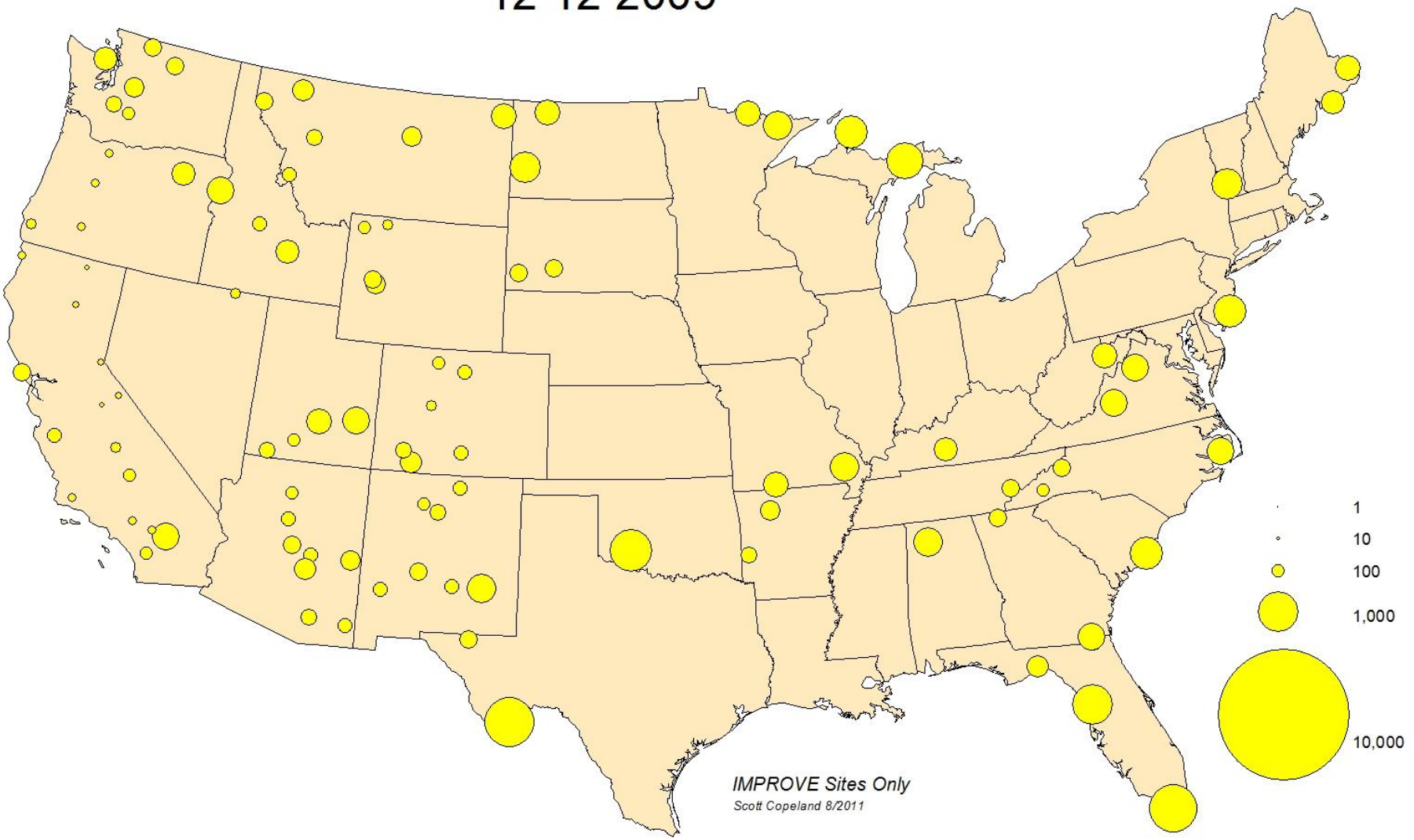

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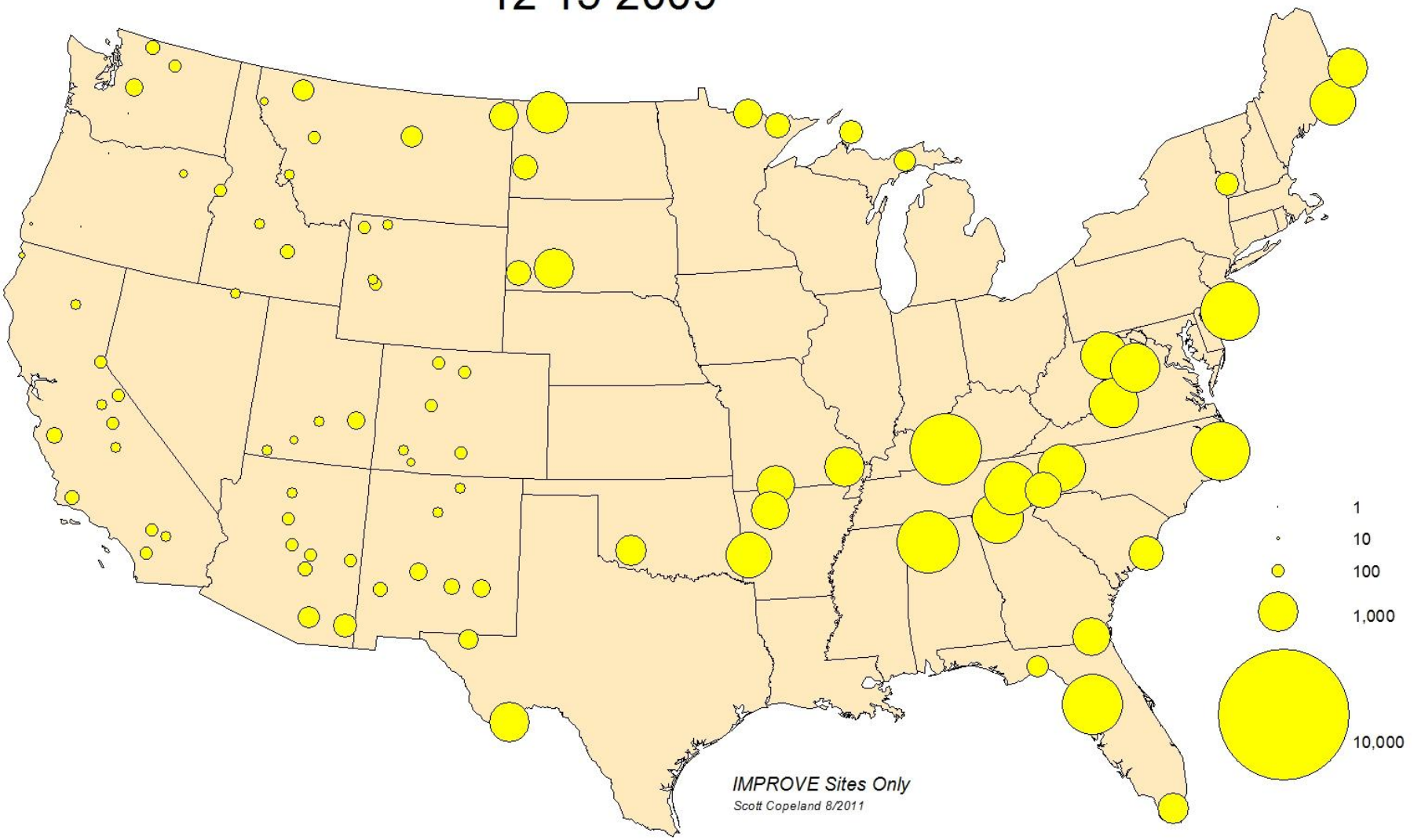

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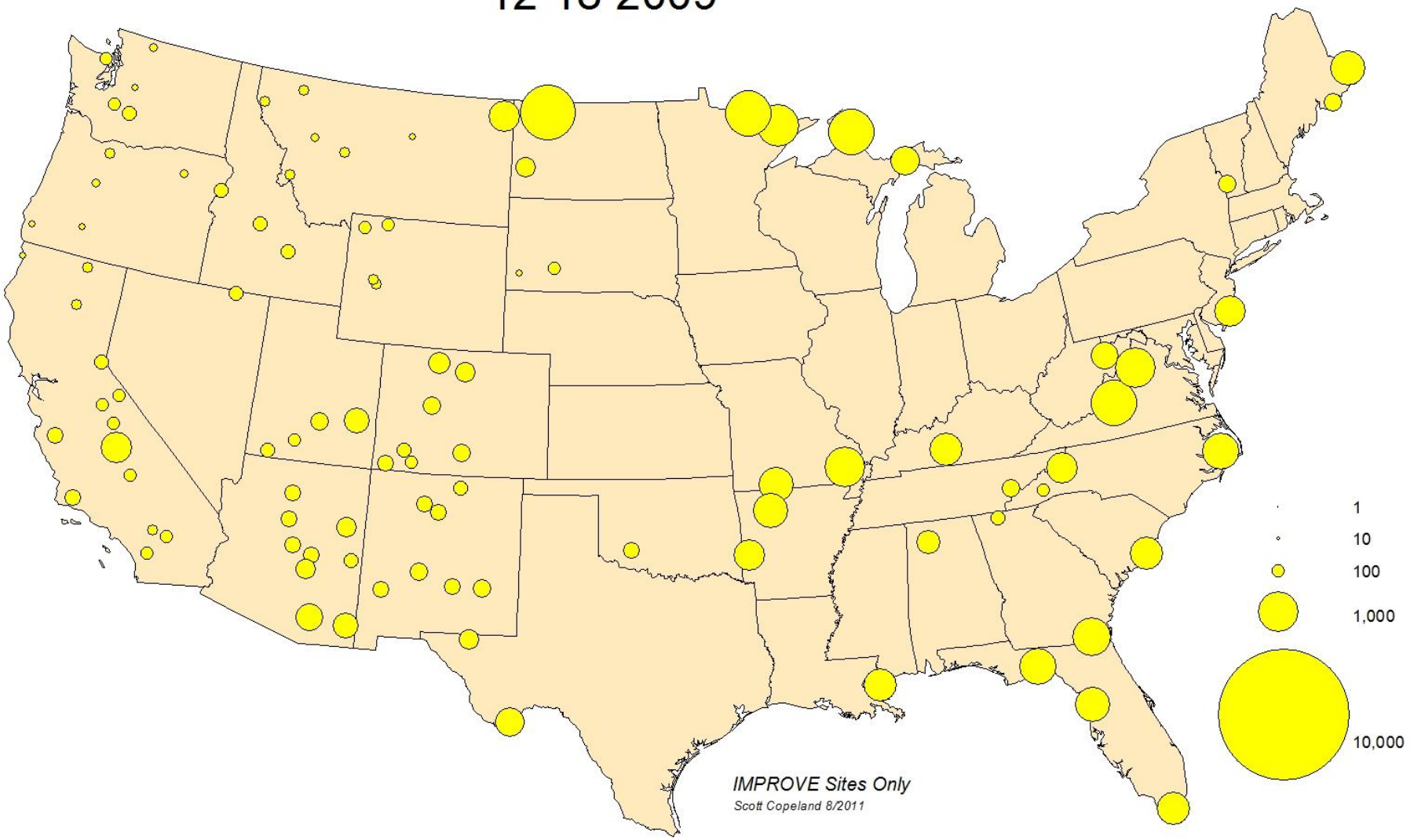

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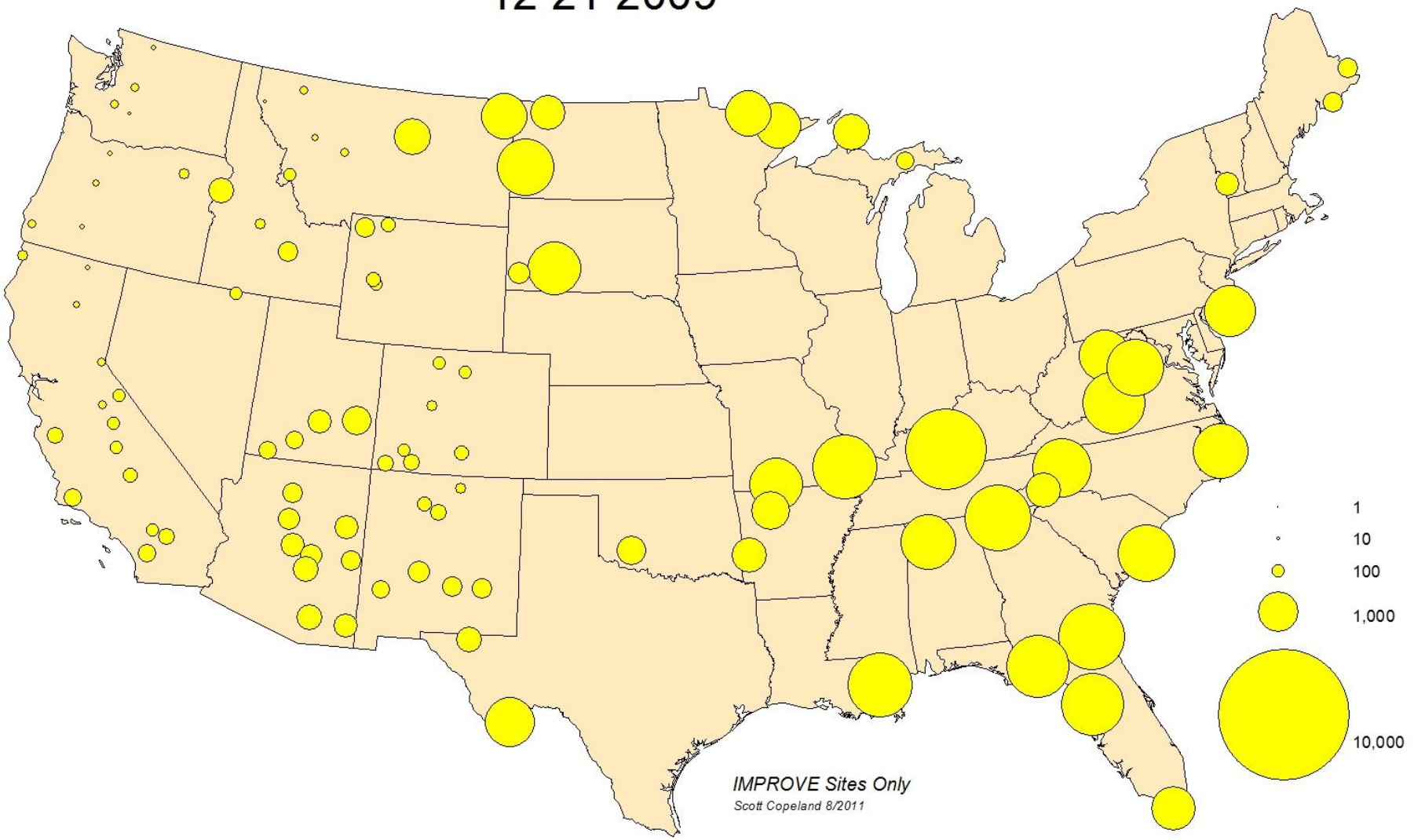

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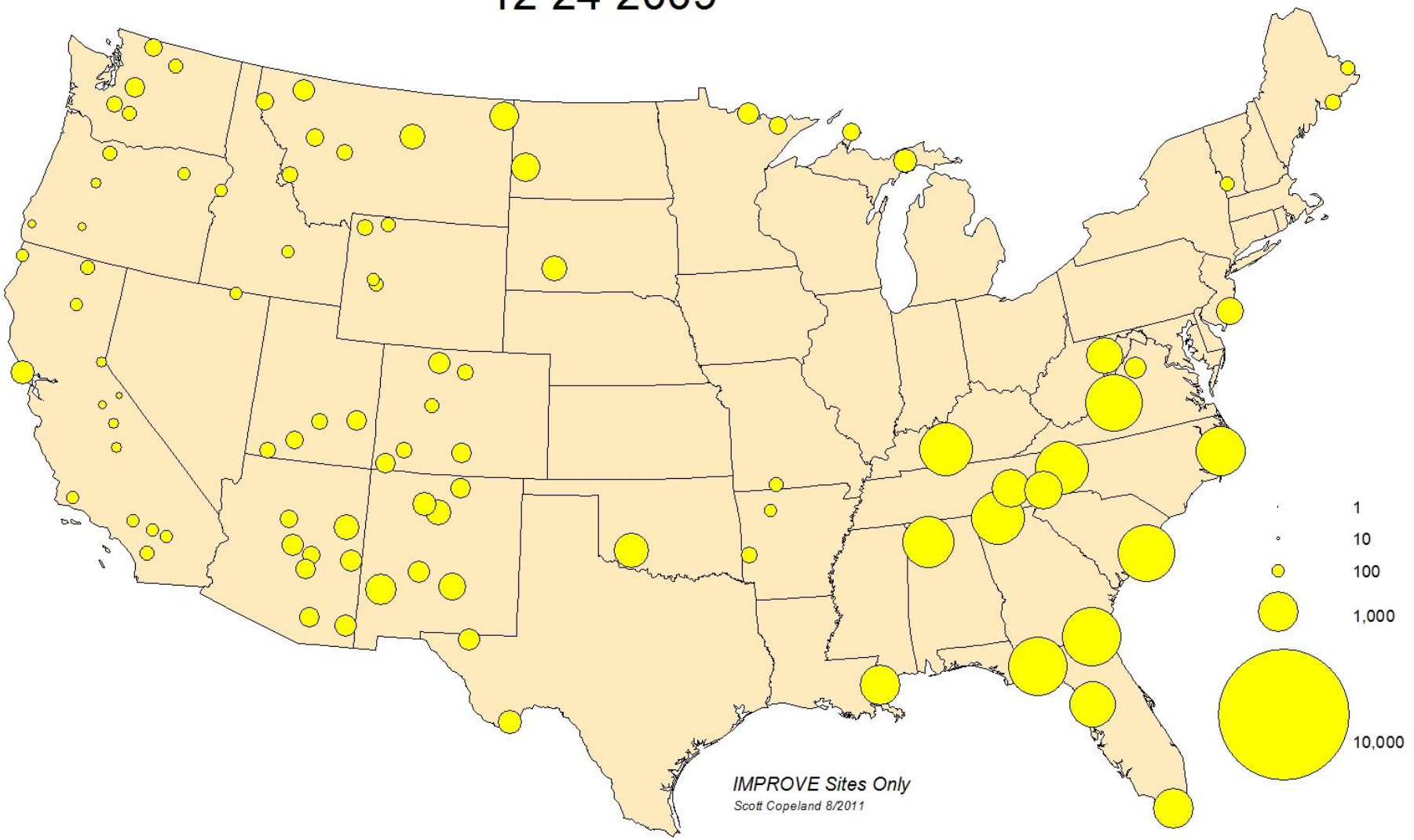

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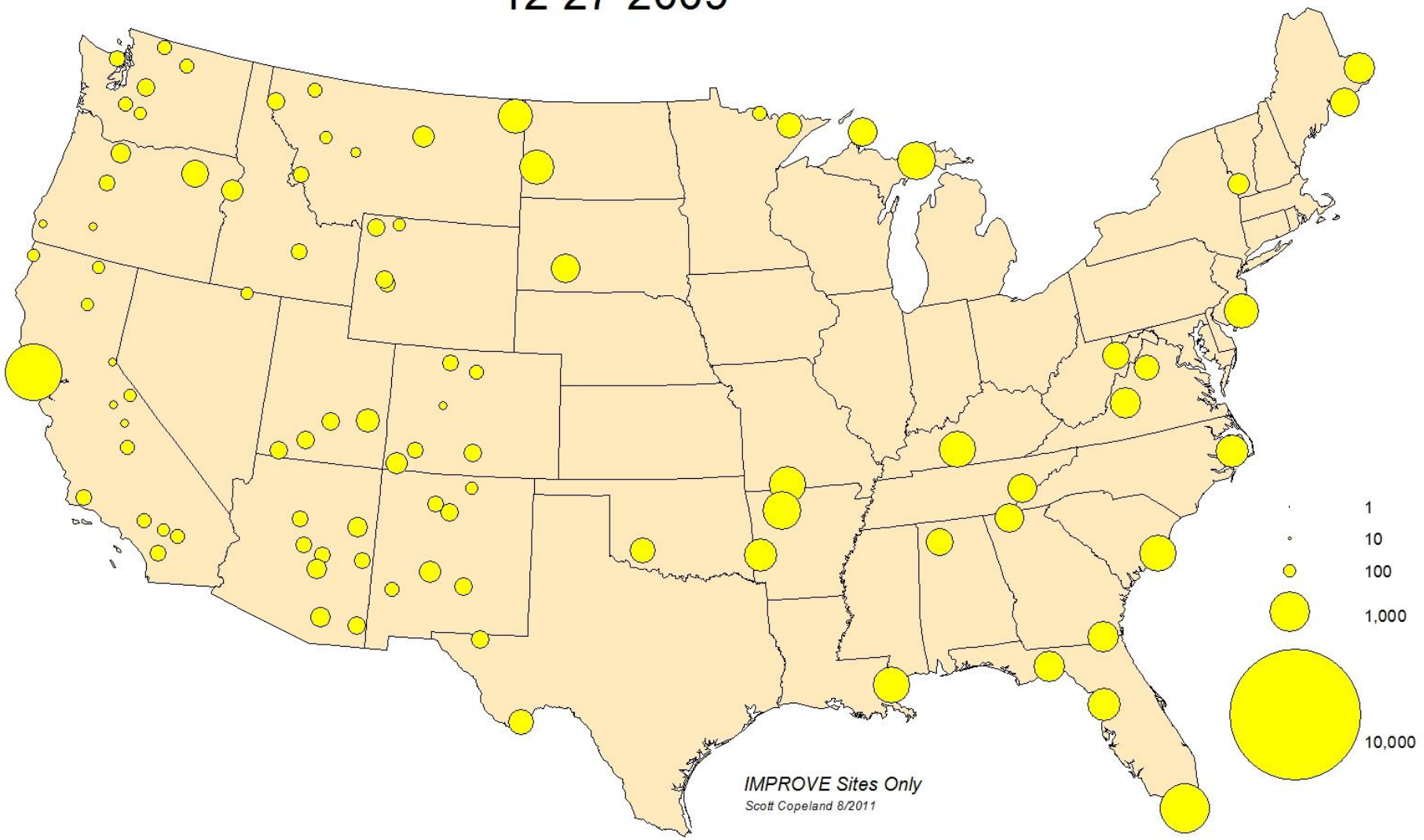

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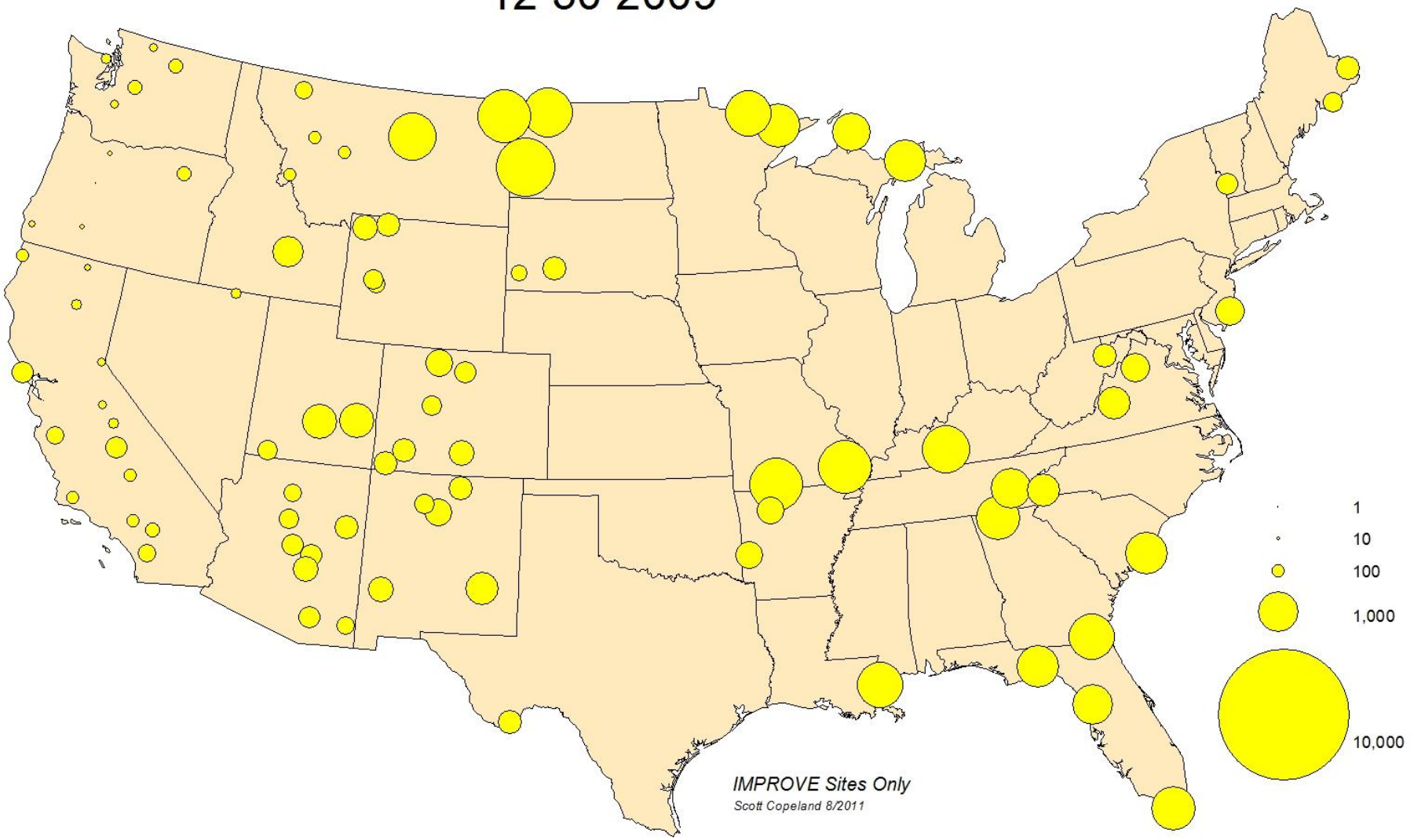

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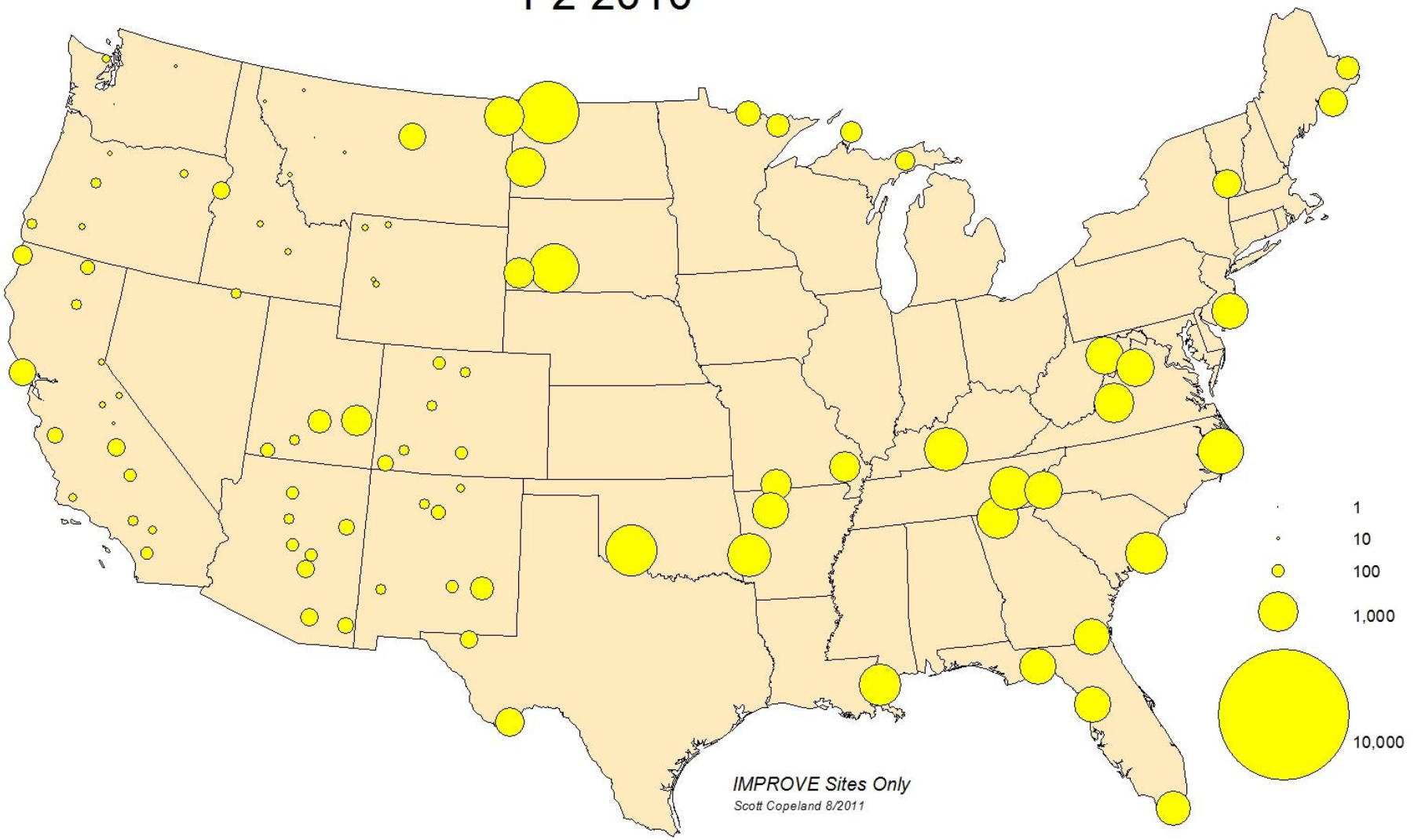

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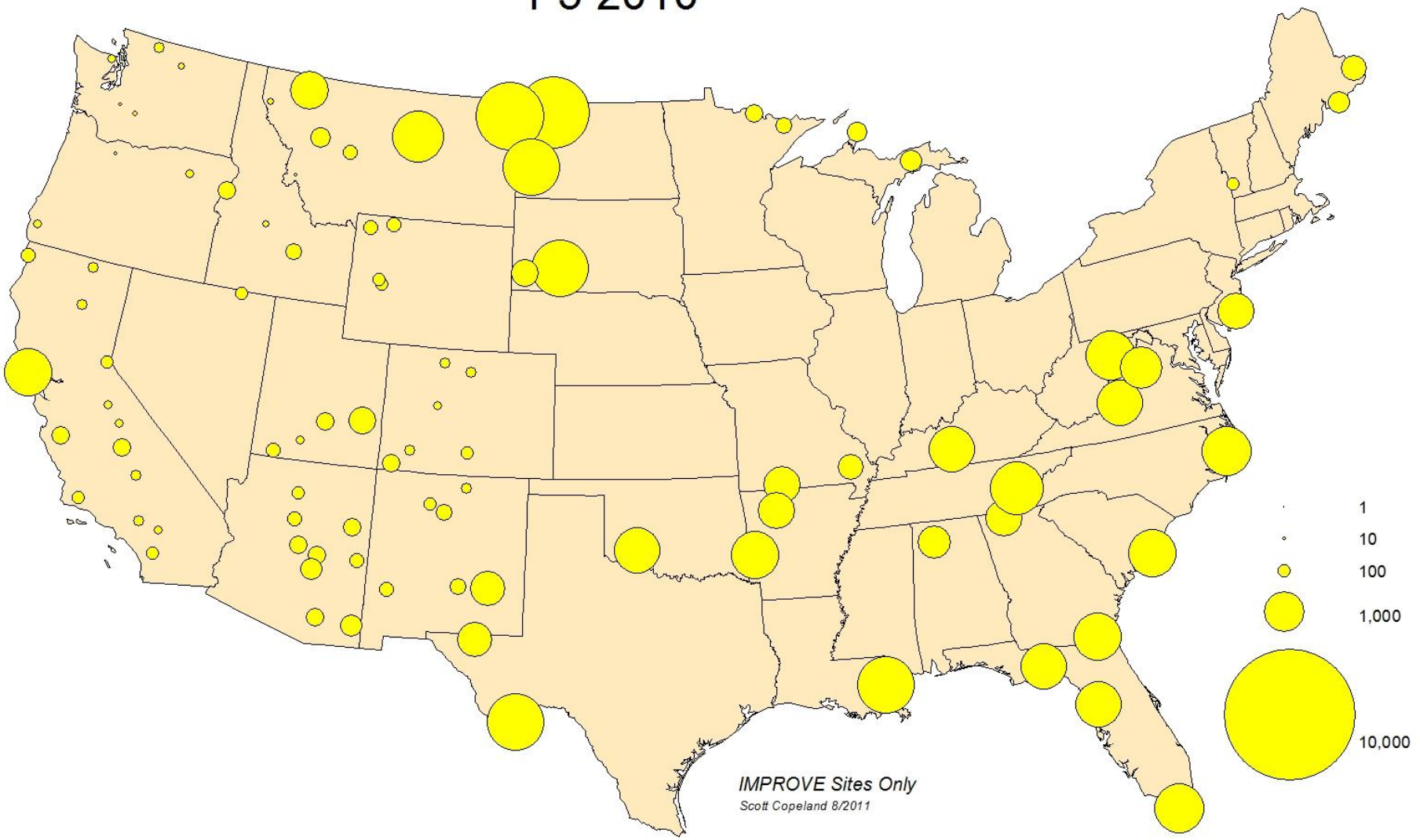

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Conclusions

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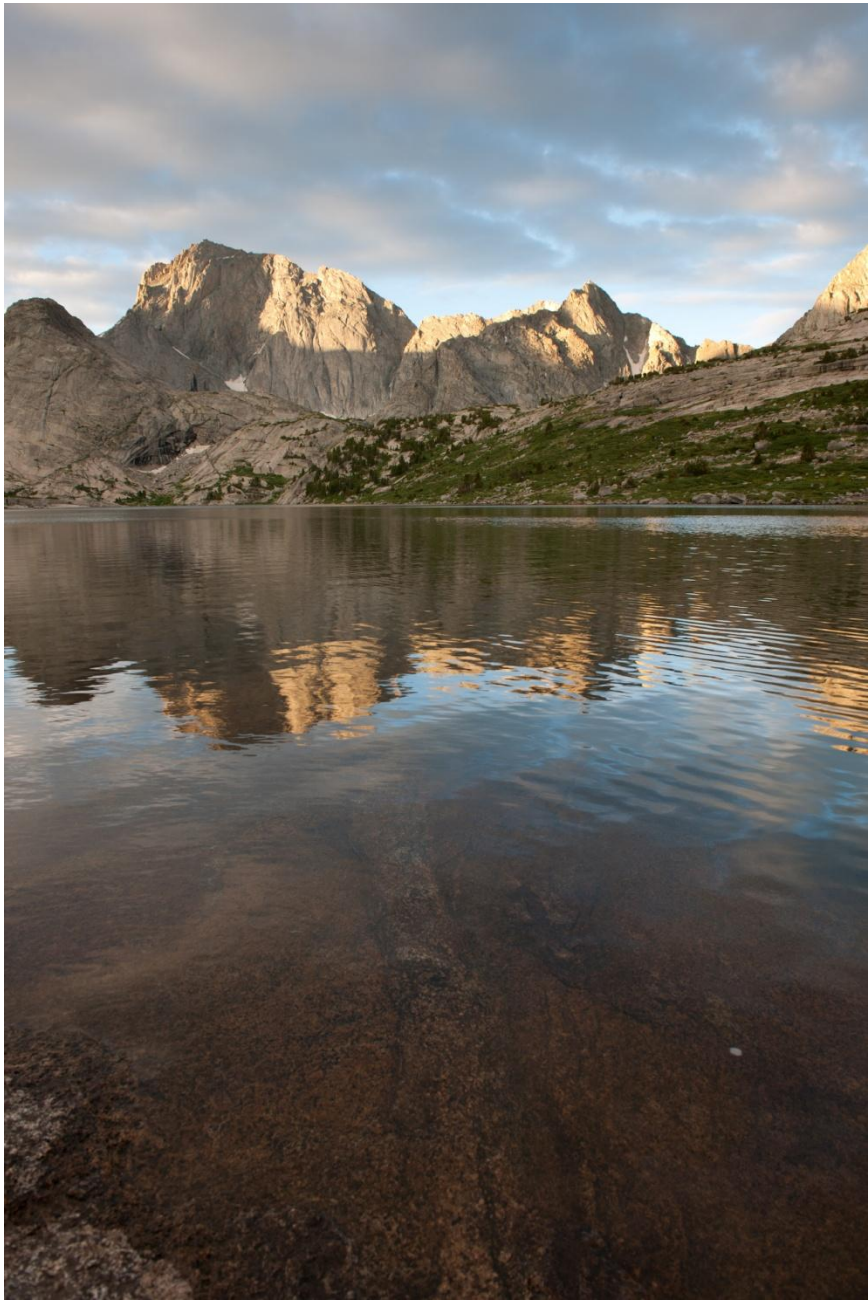
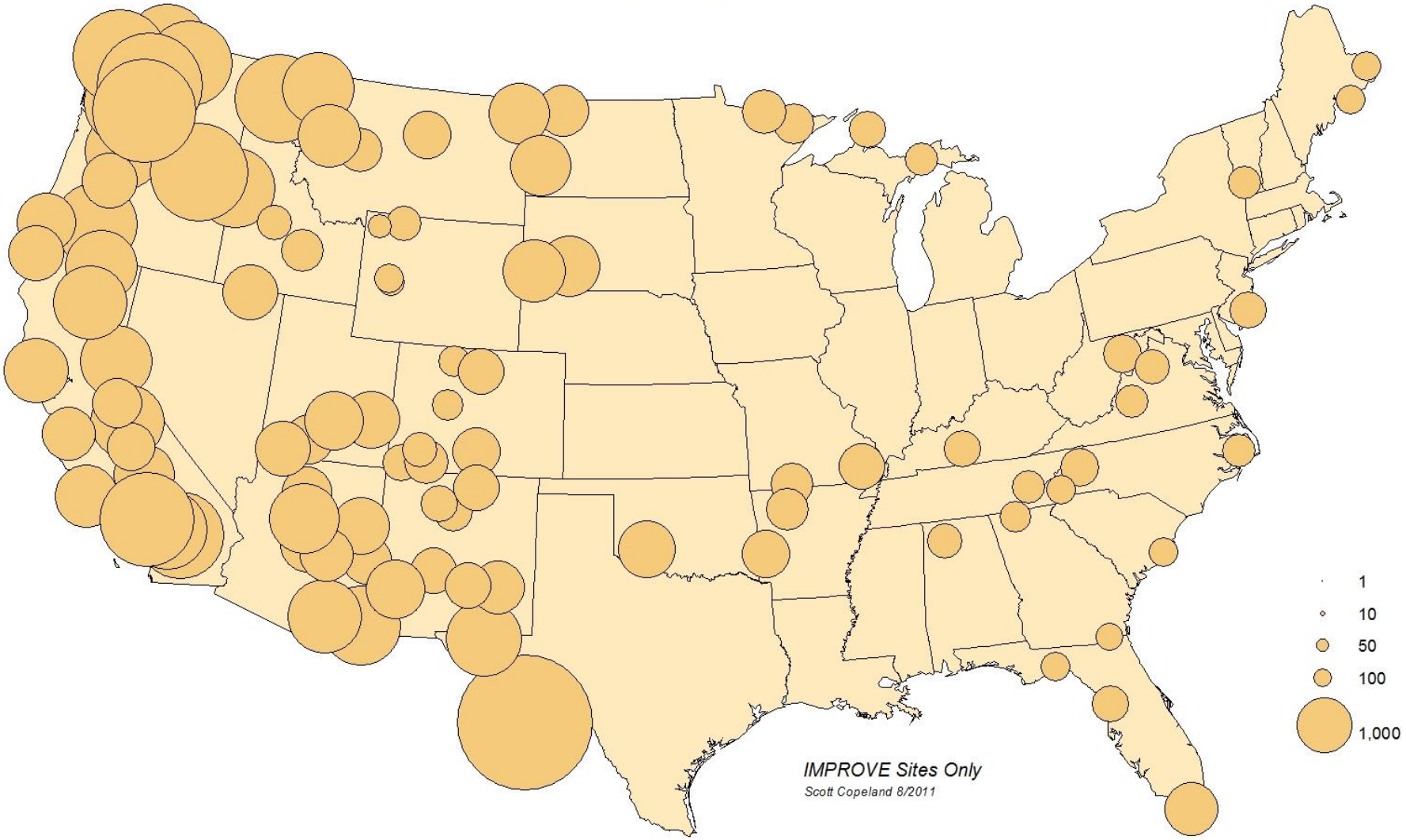


Possible Asian Dust Episode March & April 2010

IMPROVE Fine Soil Concentration (ng/m3)
3 27 2010



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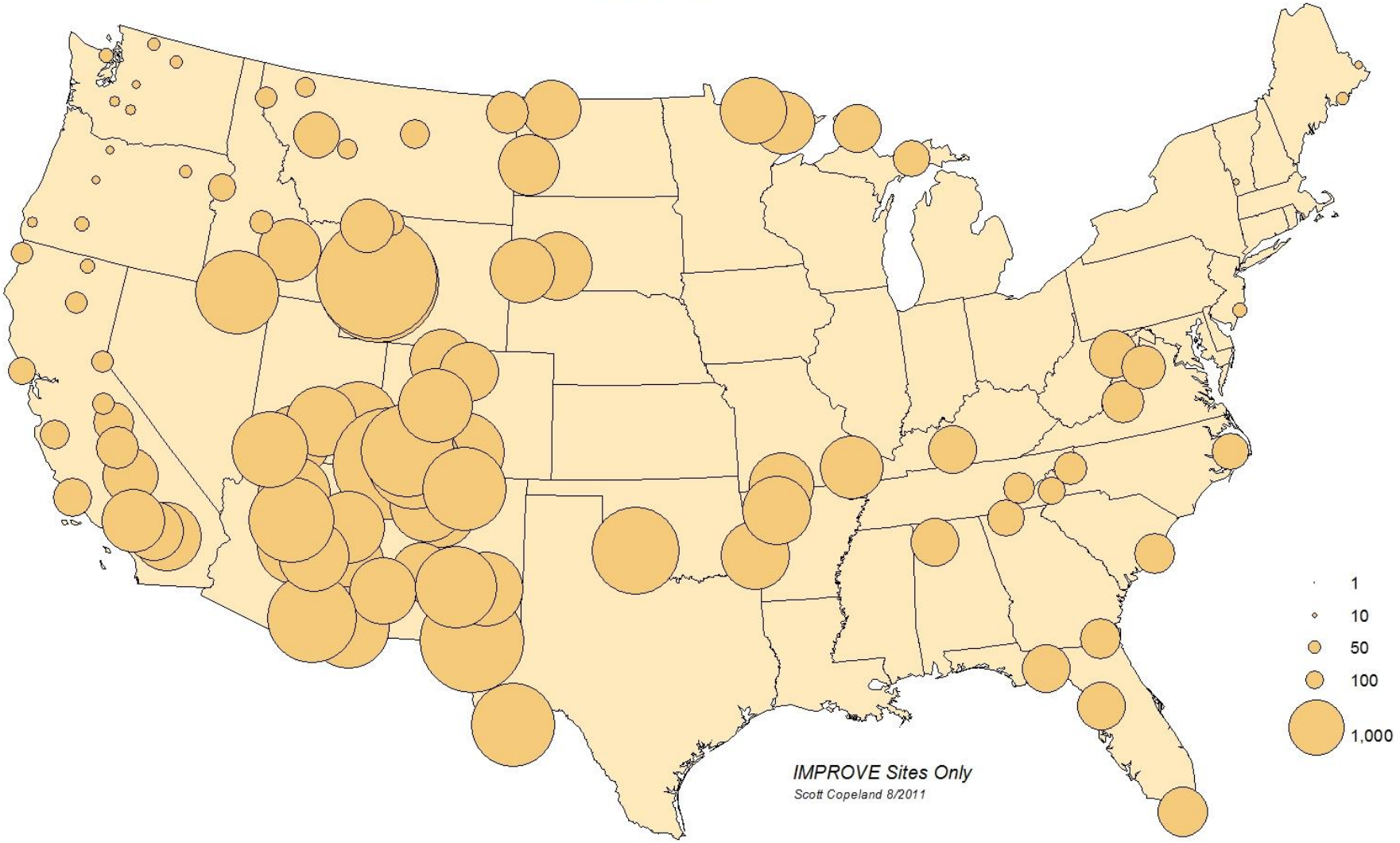

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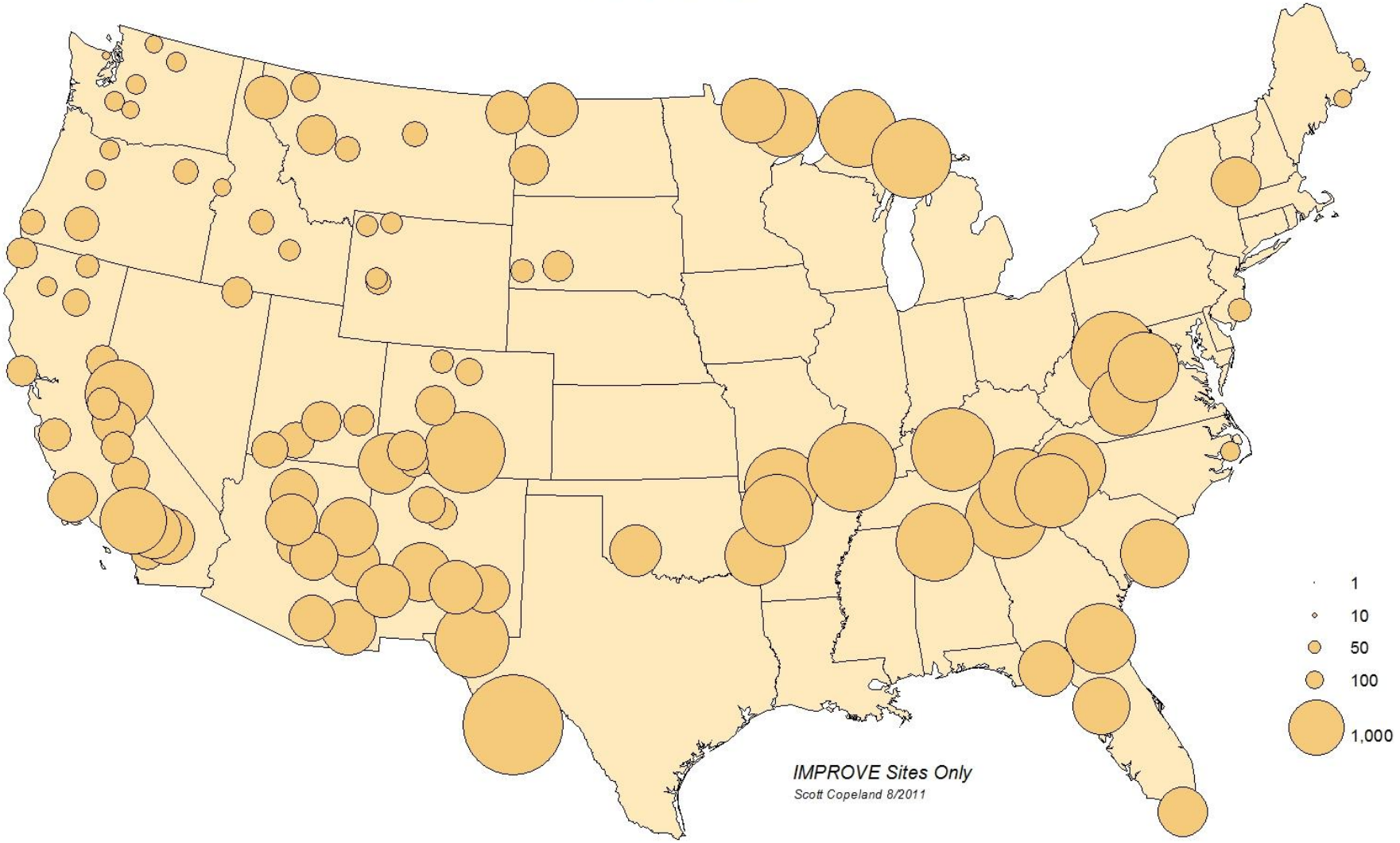

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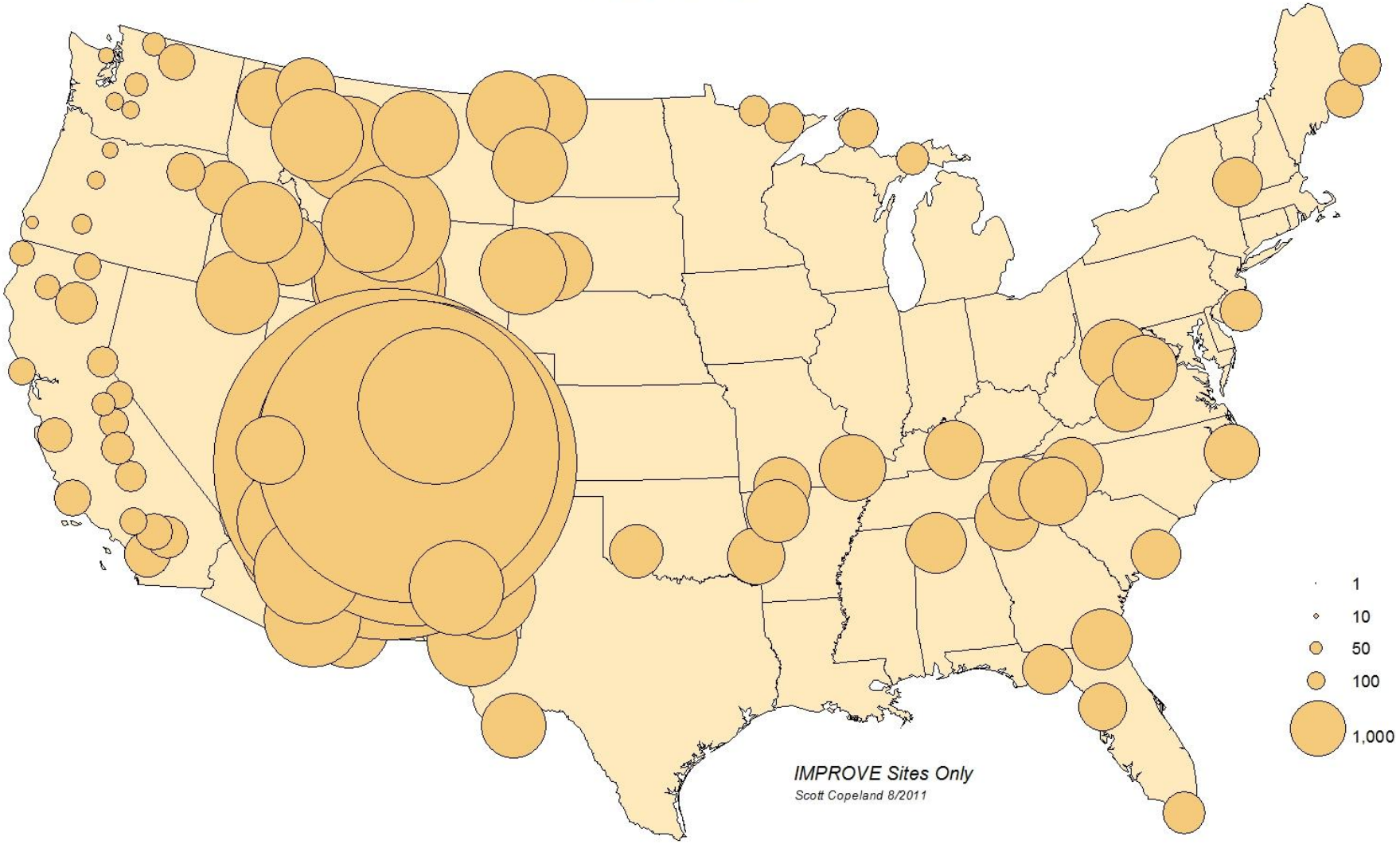

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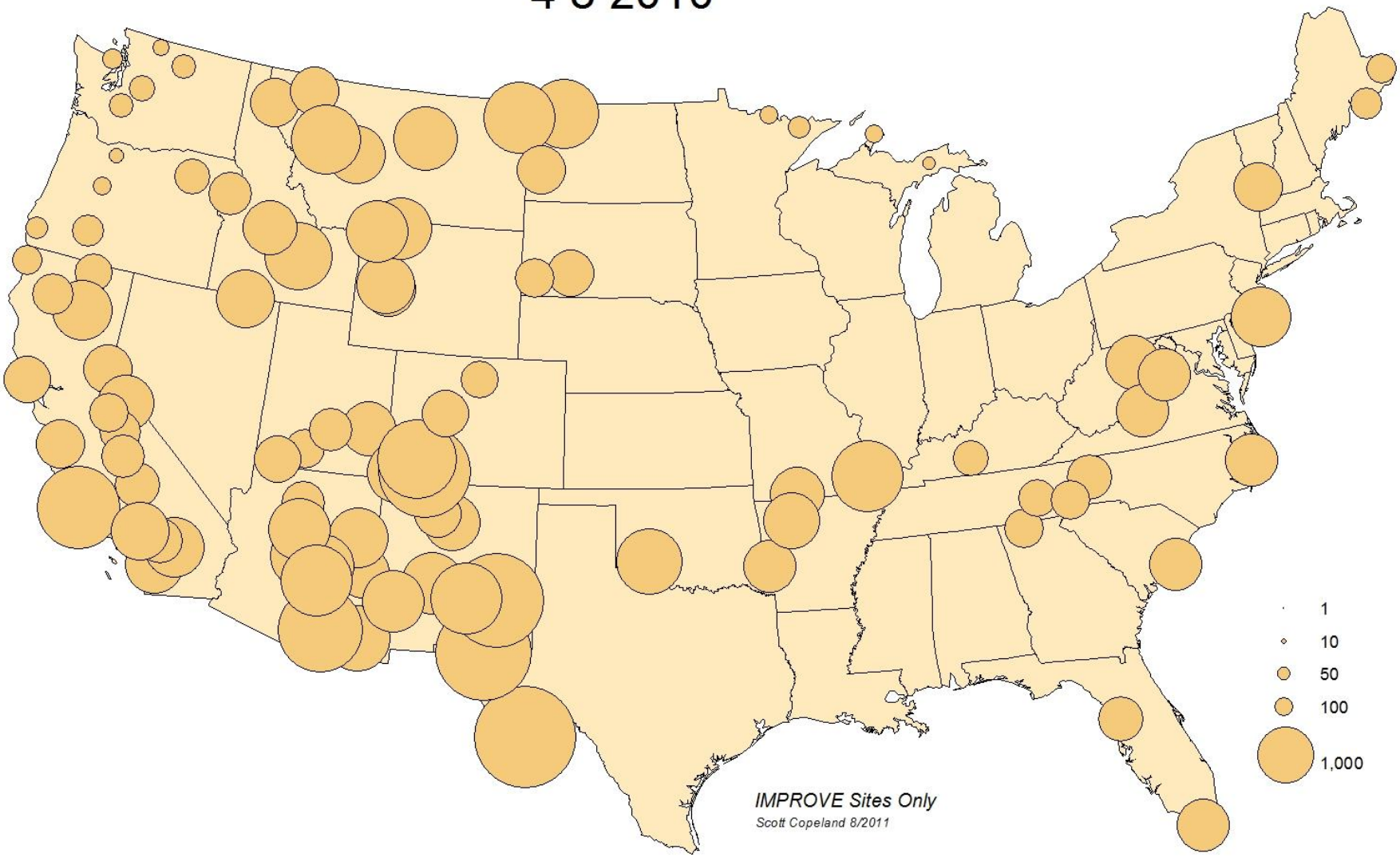

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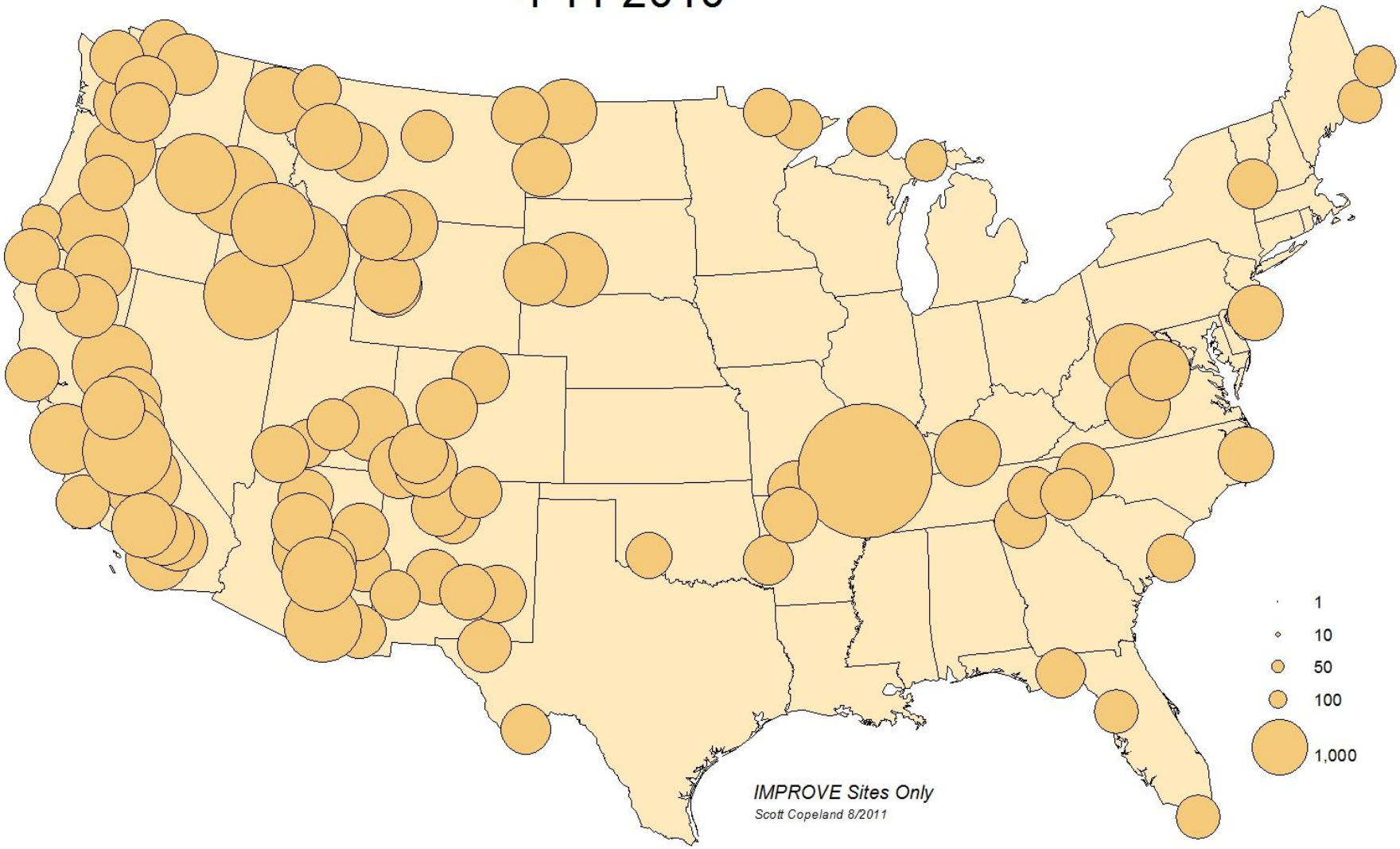

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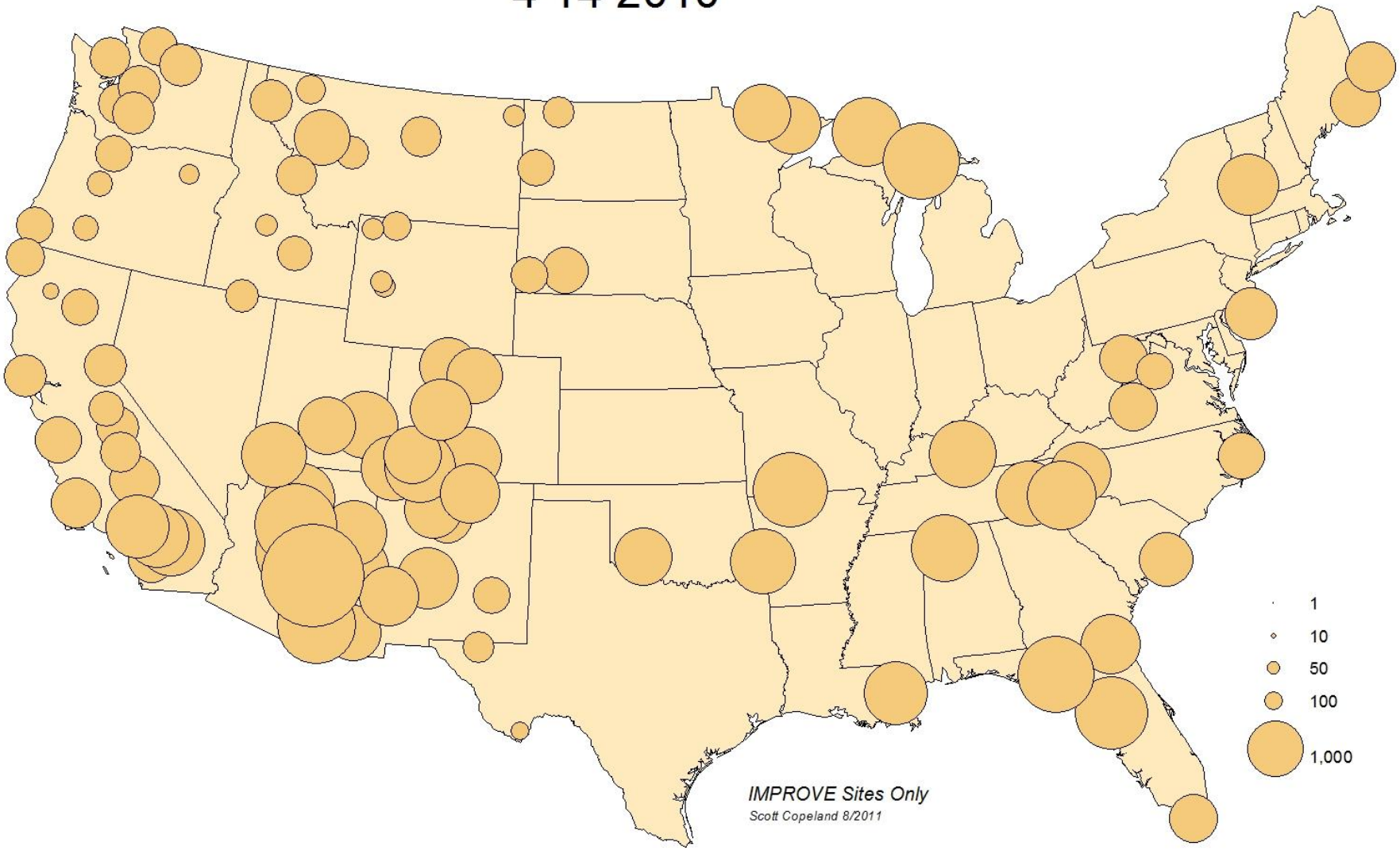

April 2010 WUG “Pinedale”